HP 3430A

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3430A DIGITAL VOLTMETER

OPERATING AND SERVICE MANUAL

HEWLETT hp PACKARD

HP 3430A

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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

MANUAL CHANGES

MODEL 3430A

DIGITAL VOLTMETER

Manual Serial Prefixed: 723-
-hp- Part No. 03430-90001

► New or Revised Item

Instrument Serial Number	Make Manual Changes	Instrument Serial Number	Make Manual Changes
ALL	ERRATA	749-02151 and above	4
749- and above	1		
749-01501 and above	2		
749-01601 and above	3		

ERRATA:

Page 5-4, Paragraph 5-19, step b:
Delete "This control is a ten turn potentiometer."

Page 6-3, Figure 6-2:
Change Part No. of MP1 to 5040-4569.

Page 6-7, Table 6-1, Replaceable Parts:
Change Part No. of A2MP1 to 5040-4569.

Page 6-8, Table 6-1, Replaceable Parts:
Change Part No. of A3MP1 to 5040-4569.

Page 6-9, Table 6-1, Replaceable Parts:
Change Part No. of A4MP1 to 5040-4569.

Page 6-10, Table 6-1, Replaceable Parts:
Change Part No. of A5CR13 thru CR18 to 1901-0158.
Change Part No. and description of A5Q1 to 1854-0090
TSTR: Si NPN.
Change Part No. and description of A5Q2, 3 to 1853-0012
TSTR: Si PNP 2N2904A.
Above parts are recommended replacement for all instruments.

Page 6-12, Table 6-1, Replaceable Parts:
Delete "ten turn" from description of R4.

Page 7-5/7-6, Figure 7-3A:
Change value of R3* to 22.6 kΩ.

CHANGE 1:

Page 6-4, Table 6-1, Replaceable Parts:
Change Part No. and description of A1Q7, 8, 12, 16, 17, 20, 23, and 27 to 1853-0036 TSTR: Si PNP 2N3906.

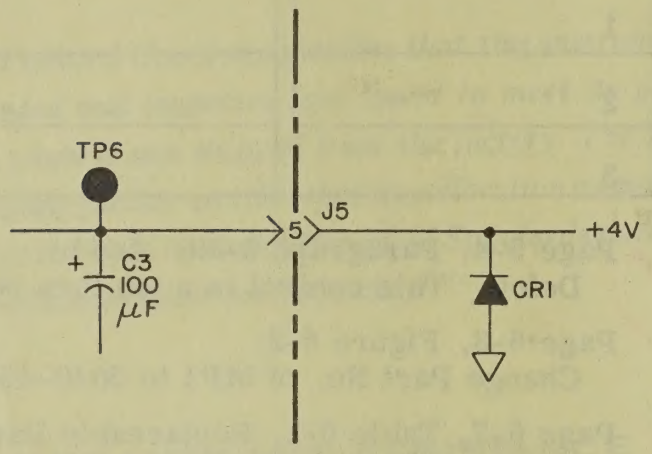
Page 6-10, Table 6-1, Replaceable Parts:
Change Part No. and description of A5Q9 and 12 to 1853-0036
TSTR: Si PNP 2N3906.

CHANGE 2:

Page 6-4, Table 6-1, Replaceable Parts:
Change Part No. of A1K1 to 0490-0703.
Change Part No. and description of A1Q6 to 1853-0012
TSTR: Si PNP 2N2904A.

Page 6-11, Table 6-1, Replaceable Parts:
Add CR1 -hp- Part No. 1901-0025, Diode: Si.

Page 7-15/7-16, Figure 7-7, Schematic Diagram A5 Power Supply Assembly:
Add CR1 as shown:



CHANGE 3:

This change implemented at factory beginning with Serial No. 749-01601, but applies to any instrument that may have the problem described.

Page 5-14, add Paragraph 5-77. A2C9*.
"The value of A2C9* may be changed to correct for lack of sensitivity to small voltage changes when there is a count of 4 in the hundreds decade. For example, if, with a count of 400 in the instrument it does not respond to an increase of 1, 2, or 3 counts in the units decade, the value of A2C9* may be increased. The maximum value permissible is 360 pF. A dipped mica capacitor should be used."

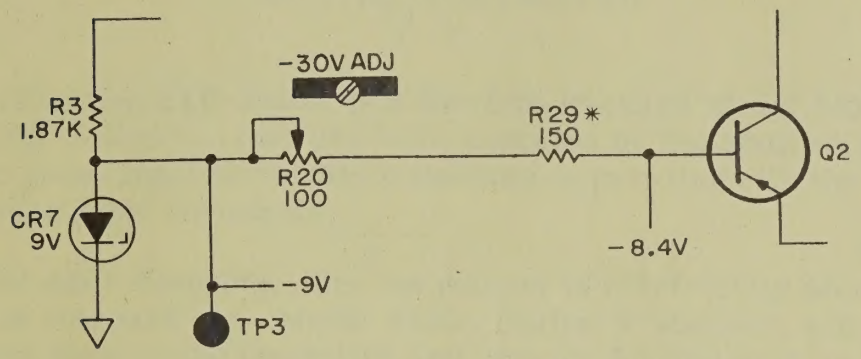
Page 6-6, Table 6-1, Replaceable Parts:
Add note in description column in reference to A2C9.
"Factory selected value. See Paragraph 5-77."

Page 7-9/7-10, Figure 7-4:
Add an asterisk following the designator C9, and change capacitor value to 240 pF.

CHANGE 4:

► Page 6-10, Table 6-1, Replaceable Parts:
Change Part No. and description of A5R20 to 2100-0290
R: var ww 100 Ω ±20% 1.5 W.
Add R29* R: fxd met flm 150 Ω ±1% 1/8 W (nominal value) 0757-0284. Actual value is factory selected to bring R20 within the proper range. Value may vary from 0 Ω to 400 Ω.

► Page 7-15/7-16 Schematic Diagram, A5 Power Supply Assembly.
Change -30 V Supply diagram as shown:



This change has been factory installed on all instruments with serial number 749-02151 and higher EXCEPT the following:

749-02153	749-02184	749-02217
749-02155	749-02186	749-02222
749-02156	749-02187	749-02223
749-02158	749-02188	749-02224
749-02159	749-02192	749-02227
749-02162	749-02193	749-02229
749-02163	749-02197	749-02232
749-02164	749-02200	749-02235
749-02165	749-02201	749-02239
749-02166	749-02204	749-02240
749-02173	749-02205	749-02241
749-02175	749-02206	749-02242
749-02178	749-02208	749-02246
749-02179	749-02212	749-02247
749-02181	749-02213	749-02248
749-02182	749-02215	749-02250
749-02183	749-02216	

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

MODIFICATIONS

SPECIFICATION C10-3430A

DIGITAL VOLTMETER

Specification C10-3430A is a Hewlett-Packard Model 3430A Digital Voltmeter that has been modified by the addition of rear panel input terminals connected in parallel with the existing input terminals.

In all other respects, this instrument is electrically identical to the standard -hp- Model 3430A Digital Voltmeter; and the information in the Operating and Service Manual applies.

Enclosure: 3430A

pla/March 1967

12-8-00000-0

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SERVICE NOTE

3430A-1B

Obsoletes: 3430A-1
3430A-1A
3430A-2
3430A-3

-hp- Model 3430A Digital Voltmeter

RETROFIT MODIFICATIONS, REPLACEMENT PARTS, AND REPLACEMENT PROCEDURES FOR IMPROVED PERFORMANCE

The following modifications, replacement parts, and replacement procedures are recommended for improved performance of -hp- Model 3430A. All modifications and replacement parts have been factory incorporated in Model 3430A beginning with the serial number listed in each section of this Service Note. The Table of Contents below lists the sections of this Service Note. This Service Note supercedes all previous 3430A Service Notes.

TABLE OF CONTENTS

I. MODIFICATION TO ELIMINATE ZERO DRIFT

(Serial number 723-01000 and below)

The following modification procedure is recommended to eliminate zero drift in Model 3430A. One or more of the following modifications may be necessary for a particular 3430A, depending upon the amount of zero drift. The necessary number of zero drift modifications should be carried out in the order listed.

Obtain a small amount of General Electric Silicon Product, Dri-Film 88 or Humiseal Protective Coating Type 1B12 (-hp- Part No. 6010-0140) for spray application. 0470-0074

Customer Service • 333 Logue Avenue, Mountain View, California 94040. Tel. (415) 968-9200

Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

Printed in U.S.A.

MODIFICATION PROCEDURE

1. Remove 3430A power cord from wall receptacle.
2. Remove top cover and hold-down bar. Remove A1, A2, A3, A4, A5, A6, A7 assemblies.
3. Protect all variable resistors on assemblies from spray coating with masking tape. Mask and protect all assembly board connector pins.
4. Spray component side of A1, A2, A3, A4, A5, A6, A7 assemblies. Special attention is directed to the input section of the A1 Amplifier Assembly, outlined in Figure 1. This section should be fully coated when spraying.
5. After drying (20 minutes), remove masking tape, replace A1, A2, A3, A4, A5, A6, A7 assemblies.
6. Perform instrument turn-on procedure as outlined in the Operating and Service Manual.
7. Observe zero drift over a two-hour period. If greater than ±1 count but less than ±4 counts, refer to Section V of Operating and Service Manual, -hp- Part No. 03430-90001 Troubleshooting Section, (Paragraph 5-75).
8. If zero drift observed is ±1 count or less, replace hold-down bar and top cover.

No further adjustment or calibration is required.

This modification has been accomplished during instrument manufacture for Model 3430A Serial no. 723-01001 and above.

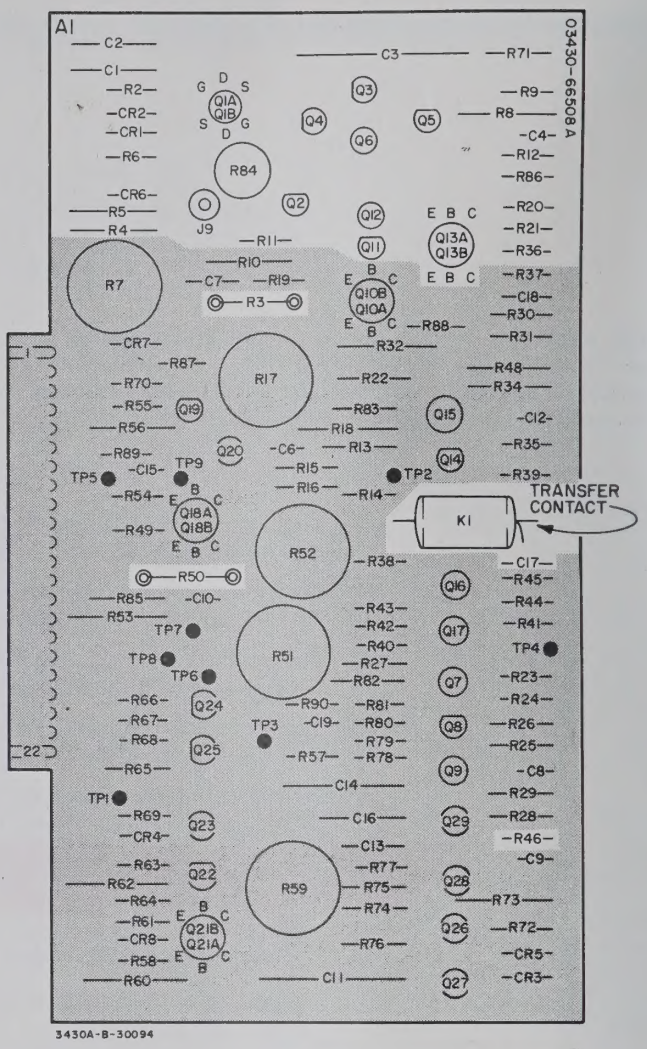


Figure 1.

II. MODIFICATION TO ELIMINATE ALTERNATING DISPLAY IN LEAST SIGNIFICANT DIGIT

(Serial number 641-00225 and below)

This modification will prevent the display from rapidly alternating between 000 and 002 with inputs corresponding to a 001 display on any range.

The modification should be made only if the ambiguous display occurs.

Remove A1R46 (see Figure 1) and replace with a 68 kΩ, ±10%, 1/4 W composition resistor, -hp- Part No. 0684-6831. Remove A1R47 and replace with A1C17, a 560 pf dipped mica capacitor, -hp- Part No. 0160-2212.

No corrections are required in Operating and Service Manual -hp- Part No. 03430-90001. To receive this manual, please fill out, detach, and return the self-addressed card in Preliminary Operating and Service Manual -hp- Part No. 03430-90000.

This modification has been accomplished during instrument manufacture for Model 3430A Serial no. 641-00226 and above.

III. REPLACEMENT FOR A1 AMPLIFIER ASSEMBLY

(Serial number 723-01000 and below)

Hewlett-Packard Part No. 03430-66508 is the direct replacement for the A1 Amplifier Assembly (-hp- Part No. 03430-66501). The A1 Assembly was modified to accommodate component changes for increased reliability.

INSTALLATION PROCEDURE

See Section VIII of this Service Note for the A1 Amplifier Assembly installation procedure.

No corrections are required in your Operating and Service Manual -hp- Part No. 03430-90001. To receive this manual, please fill out, detach and return the self-addressed card in Preliminary Operating and Service Manual -hp- Part No. 03430-90000.

The new A1 Amplifier Assembly, -hp- Part No. 03430-66508, is factory installed in Model 3430A Serial number 723-01001 and above.

IV. REPLACEMENT FOR A1K1 REED RELAY

(Serial number 723-01000 and below)

Hewlett-Packard Part No. 0490-0703 is the recommended replacement for the A1K1 Reed Relay (-hp- Part No. 0490-0391). The new relay incorporates more reliable reeds and also flexible leads to eliminate welded connections.

The new relay is a direct replacement for the A1K1 relay. Replacement should only be made if relay failure occurs.

NOTE

Care should be taken when bending the flexible leads of the new relay for insertion into the holes on the A1 Board. Bend leads in a fashion to minimize stress at the relay body-lead interface.

No adjustment or calibration procedure is required after installation of -hp- Part No. 0490-0703.

Correct your Operating and Service Manual to show that if replacement of A1K1 is required, the replaceable part is -hp- Part No. 0490-0703.

The new A1K1 relay is factory installed in Model 3430A Serial number 723-01001 and above.

V. REPLACEMENT TRANSISTORS FOR A1 AMPLIFIER ASSEMBLY AND A5 REGULATOR ASSEMBLY

(Serial number 723-01300 and below)

Hewlett-Packard Part No. 1853-0036 is the recommended replacement for transistors:

A1Q6	A1Q17	A5Q2
A1Q7	A1Q20	A5Q3
A1Q8	A1Q23	A5Q9
A1Q12	A1Q27	A5Q12
A1Q16		

The new transistor is more readily available and has increased reliability. It is a direct replacement for -hp- Part No. 1853-0069.

Replacement should only be made if transistor failure occurs.

Correct your Operating and Service Manual to show that if replacement of any of the above transistors is required, the replaceable part is -hp- Part No. 1853-0036.

Hewlett-Packard Part No. 1853-0036 is a factory installed part in Model 3430A Serial no. 749-01301 and above.

VI. REPLACEMENT FOR MP5 HOLD DOWN BAR

(Serial number 641-00700 and below)

Hewlett-Packard Part No. 5040-4563 is the recommended replacement for the original printed circuit board hold down bar (-hp- Part No. 5040-0641). The new bar is more rigid and provides for a more secure seating of the printed circuit boards.

Hold down bar replacement is recommended as a routine to be performed on any 3430A having the older type hold down bar.

VII. REPLACEMENT FOR NIXIE SOCKET MP1

(Serial number 723-01000 and below)

Hewlett-Packard Part No. 5040-4569 is the recommended replacement for Nixie Tube Socket (-hp- Part No. 5040-0641). The new nixie socket has larger, "floating" pin receptacles to eliminate stress on nixie tube pins and resulting tube breakage.

Socket replacement is recommended when tube breakage occurs.

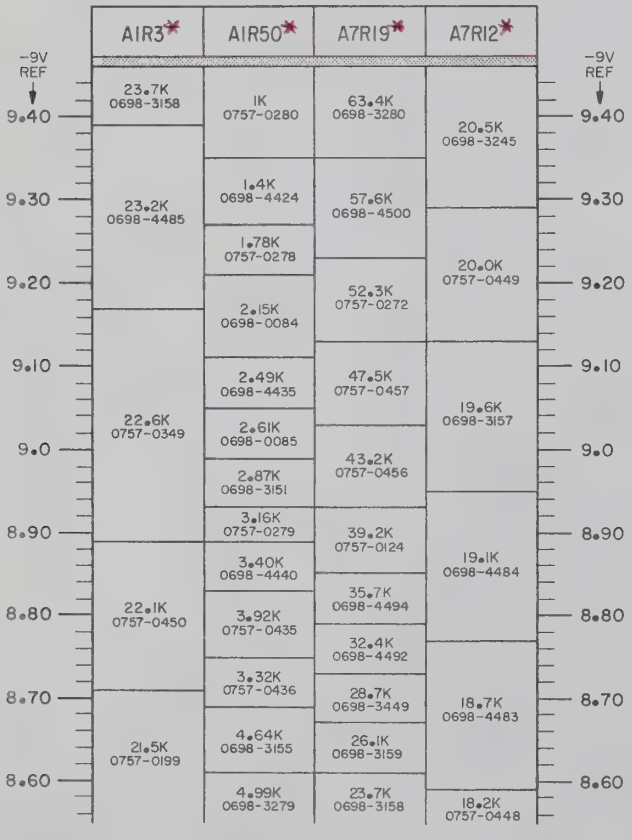
REPLACEMENT PROCEDURE

1. Remove power cord from wall receptacle.
2. Remove top cover and hold down bar. Remove assembly with nixie socket to be replace.
3. Remove damaged nixie tube from socket. Disconnect soldered wires from Nixie Tube Socket.
4. Remove two screws securing socket to photo-conductor block and remove nixie socket.
5. Solder wires to new socket pins 0 through 9 according to NEMA color code. Solder red-white wire to pin A+. No connection to pin marked with dot.
6. Secure new socket, -hp- Part No. 5040-4569 to photoconductor block. Install with pin 6 (blue wire) of socket, as viewed from rear, nearest top of assembly board (top opposite connector pin side).
7. Insert nixie tube into new socket. Replace assembly, hold down bar, and top cover.
8. Check instrument for all proper numerical indications in that decade

The new socket, -hp- Part No. 5040-4569, is a factory installed part in Model 3430A Serial number 723-01001.

VIII. REPLACEMENT PROCEDURE FOR A1 AMPLIFIER ASSEMBLY OR A7 REFERENCE AMPLIFIER ASSEMBLY

The following procedure is recommended for replacement of the A1 Amplifier Assembly Board, -hp- Part No. 03430-66508, or the A7 Reference Amplifier Board, -hp- Part No. 03430-66507. This procedure is required because of the use of factory selected (*) resistors A1R3,* A1R50,* and A7R12,* A7R19.*



ALL RESISTOR VALUES ±1%, 1/8W METAL FILM
-HP- PART NUMBERS SHOWN

Table 1.

The value of A1R3,* A1R50,* or A7R12,* A7R19,* which should be selected for the respective board depends directly upon the actual zener diode voltage of the -9 V reference supply, which can be measured at A5TP3 of Model 3430A.

Table 1 gives the value of A1R3,* A1R50,* A7R19,* or A7R19,* which corresponds to the measured zener diode voltage. To use Table 1, place a straight edge across the table at the measured reference voltage and determine the resistor value in the appropriate column. The -hp- part number for each resistor is listed below the resistor value in the table.

REPLACEMENT PROCEDURE

1. Remove A1 and A7 Assembly Boards.
2. Turn Model 3430A on. Allow instrument to warm-up for 10 minutes.
3. Measure the -9 V reference supply voltage at A5TP3. A measuring instrument with a DC voltage resolution of 0.1% (3430A) or better is recommended.
4. Determine the required value of A1R3,*A1R50,* or A7R12,* A7R19* from Table 1.
5. Locate A1R3* and A1R50* on the A1 Board (see Figure 1) or A7R12,* and A7R19* on the A7 Board (see Figure 2). If the value of either resistor differes from the value determined in Table 1 for the corresponding resistor, remove the existing resistor from the board.
6. Replace the missing resistors on the A1 or A7 Board with the proper values determined in Table 1.
7. Turn Model 3430A off. Replace the A1 Amplifier Assembly Board or A7 Reference Amplifier Board.

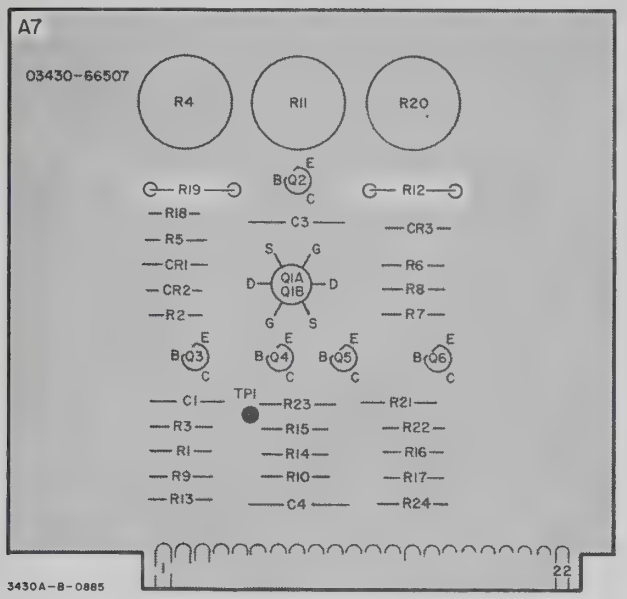


Figure 2.

After A1 Amplifier Assembly Board replacement, perform the Staircase Amplifier Zero and Gain Adjustment as outlined in the Operating and Service Manual.

After A7 Reference Amplifier replacement, perform the Ratio Calibration as outlined in the Operating and Service Manual.

IX. REPLACEMENT PROCEDURE FOR A5CR7 BREAKDOWN DIODE

The following procedure is recommended for replacement of the breakdown diode A5CR7, -hp- Part No. 1902-0071. This procedure is required because of the use of factory selected (*) resistors A1R3,* A1R50,* A7R12,* and A7R19.* The value of these resistors depends directly upon the actual measured breakdown voltage of A5CR7.

REPLACEMENT PROCEDURE

1. Remove the 3430A power cord from the wall receptacle.
2. Remove the top cover. Remove the circuit board hold-down bar MP5. Remove the A5 regulator assembly (-hp- Part No. 03430-66505).
3. Remove A5CR7 and replace with -hp- Part No. 1902-0071. Replace A5 regulator assembly. Do not replace hold down bar.
4. Replace 3430A power cord in wall receptacle.
5. Carry out steps 1 through 7 in Replacement Procedure under Section VIII of this Service Note.

Perform the Adjustment and Calibration Procedures as outlined in the Operating and Service Manual.

X. ADDITION OF DIODE TO 4 VOLT POWER SUPPLY

Component damage may result in the Model 3430A because of the negative transient generated in the +4 volt supply when the instrument is turned off. To eliminate this possibility, make the circuit modification shown.

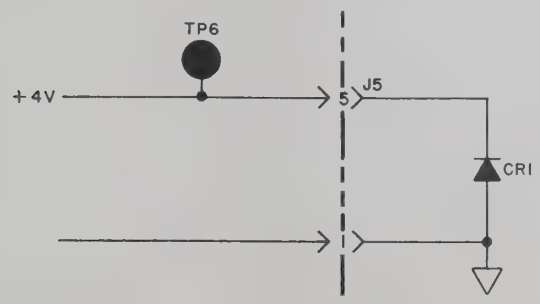


Figure 3.

The diode should be soldered between pins 5 and 1 of J5 with the cathode connected to pin 5 as shown in Figure 3. Use -hp- Part No. 1901-0025 for CR1.

This change has been incorporated in all production units starting with serial number 749-01401. The change should be performed on all 3430A's not so modified.

No recalibration is required; however, the Operating and Service Manual schematic diagram and parts list should be changed to reflect the added circuitry.

February 1968-9

OPERATING AND SERVICE MANUAL

(HP PART NO. 03430-90001)

MODEL 3430A
DIGITAL VOLTMETER

SERIALS PREFIXED: 723-

Appendix C, Manual Backdating Changes,
adapts manual to serials prefixed 641-.

P.O. Box 301, Loveland, Colorado 80537 U.S.A.

01804-1

Printed: OCT 1967

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LIST OF TABLES

LIST OF ILLUSTRATIONS

Table 1-1. Specifications

VOLTMETER

Voltage Ranges: Full scale presentation of ±100.0 mV, 1000 mV, 10.00 V, 100.0 V and 1000 V (plus up to 60% overrange indicated with 4th digit). Maximum input is 1000 V. Range selection is manual, with automatic decimal point positioning. Polarity selection and indication are automatic.

Voltage Accuracy: ±(0.1% of reading + 1 digit) from 15°C to 35°C on all ranges. ±(0.25% of reading + 1 digit) from 0°C to 15°C and 35°C to 50°C on all ranges.

Stability: Rated accuracy is met after a 10 minute warm-up period. The voltage accuracy is guaranteed for three months. Zero stability is better than 25 μV/°C. Zero should be adjusted if the operating source resistance is > 100 kΩ on the 100.0 mV range.

Response Time: Input amplifier responds to 99.9% value of a step input in 0.5 seconds.

Input Resistance: 10 MΩ ±3.0% on all ranges.

Superimposed Noise Rejection: 40 dB at 60 Hz, increasing 12 dB/octave at higher frequencies.

Input Isolation: Floating; low side (middle terminal on the front panel) may be operated up to ±500 Vdc with respect to chassis ground (350 V rms).

Effective Common Mode Rejection: Ratio of common mode signal to resultant error in readout.

DC: > 90 dB on 100.0 mV range, decreasing 20 dB per range.

AC: > 90 dB on 100.0 mV range, decreasing 20 dB per range.

DC Amplifier Output: ±16 Vdc maximum into 16 kΩ minimum resistance for input of 60% overrange. ±10 Vdc maximum into 10 kΩ minimum resistance for full scale input. Non-inverting voltage gain, (3430A input to amplifier output), is 100 on the 100 mV Range, decreasing by a factor of 10 on each higher range. Gain accuracy: ±0.1% from 15°C to 35°C, ±0.15% from 0°C to 15°C and 35°C.

Sample Rate: Fixed, at 2 per second.

Power: 115 or 230 volts ±10%, 50 to 1000 Hz, approximately 20 watts.

RATIO OPTION

Reference Input Range: 0.8 to 1.2 Vdc either polarity (selected at rear panel) for rated accuracy. Instrument is usable with reference voltage between 0.2 and 1.3 V.

Reference Input Resistance: 50 kΩ ±2% for positive reference, 511 kΩ ±2% for negative reference.

Front Terminal Input Range: 100.0 mV full scale nominal on lowest range to 1000 V maximum on highest range, either polarity, with automatic polarity indication.

Front Terminal Input Resistance: 10 MΩ ±3% on all ranges.

Ratio Accuracy: ±(0.15% of reading + 1 digit) 15°C to 35°C. ±(0.30% of reading + 1 digit) 0°C to 15°C and 35°C to 50°C.

Maximum Correct Indication: 1599 for reference inputs between 0.8 V and 1.0 V. 1333 for reference inputs between 1.0 V and 1.2 V.

GENERAL

Dimensions: 7-25/32 in. wide, 6-17/32 in. high, 12 in. deep (190 x 166 x 334 mm).

Weight: 9-3/4 lbs. (4.39 kg); Shipping: 12 lbs. (5.4 kg).

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 3430A is a dc digital voltmeter capable of measuring dc voltages from ±100 mV full scale to ±1000 V full scale with an accuracy of ±(0.1% of reading + 1 count). The Model 3430A can measure voltages up to 60% overrange on any range except the 1000 V range. Polarity is automatically indicated. A display storage circuit stores the last completed reading until a new reading is made, eliminating any computation blink. Complete specifications for the 3430A are listed in Table 1-1.

1-3. OPTION 01.

1-4. Option 01 enables the Model 3430A to measure dc voltage ratios with an accuracy of ±(0.15% of reading + 1 count).

1-5. INSTRUMENT AND MANUAL IDENTIFICATION.

1-6. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 3430A described in this manual.

Figure 1-1. 3430A Digital Voltmeter

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 3430A Digital Voltmeter. Included are initial inspection procedures, power and grounding requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 3430A can be operated from any source of 115 or 230 volts at 50 to 1000 Hz. The 115/230 V slide switch on the rear panel selects the desired line voltage. Power dissipation is approximately 20 watts.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-10. INSTALLATION.

2-11. The Model 3430A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 50°C (122°F) or the relative humidity exceeds 95%.

2-12. BENCH MOUNTING.

2-13. The Model 3430A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. The Model 3430A may be rack mounted by using an adapter frame (-hp- Part No. 5060-0797). The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office locations.)

2-16. COMBINATION MOUNTING.

2-17. The Model 3430A may be mounted in combination with other submodular units by using a Combining Case (-hp- Model 1051A or 1052A). The Combining Case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-18. REPACKAGING FOR SHIPMENT.

2-19. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-20 if the original container is to be used; 2-21 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-20. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

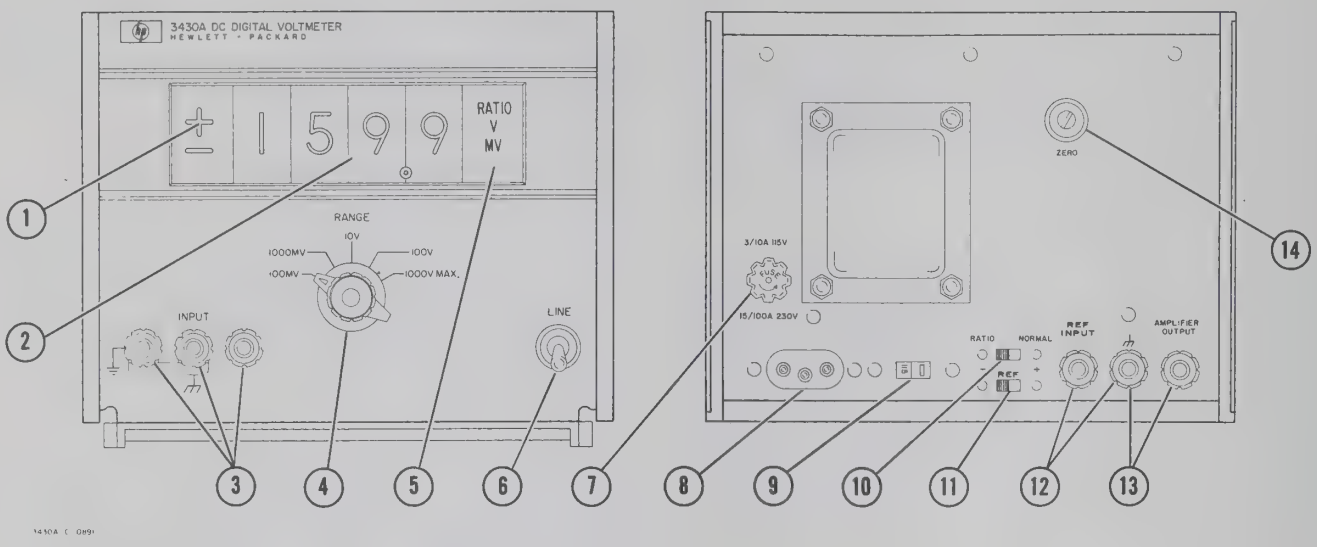
2-21. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.



(1) Polarity Indicator: Indicates input voltage polarity.

(2) Illuminated Readout Display: Indicates magnitude of voltage and position of decimal point.

(3) INPUT: Input voltage is applied between the High (red) and Common (⏚) terminals. A shorting bar provided with the instrument allows the input signal to be referenced to chassis ground when connected between the instrument common (⏚) and chassis ground (⏚) terminals.

(4) RANGE Switch: Selects full scale input. Controls decimal point and multiplier indicator.

(5) Multiplier Indicator: Indicates instrument measurement unit: (V or mV) and RATIO (Option 01 only).

(6) LINE SWITCH: Applies primary power to instrument.

(7) 115/230 Volt Fuse: For 115 volt operation a 2/10 A. 125 V slow-blow fuse is used; for 230 volt operation a 15/100 A. 250 V slow-blow fuse is used.

(8) AC Power Connector: Connects to the primary power cable supplied with the instrument.

(9) 115/230 Slide Switch (S3): Selects either 115 or 230 volt operation.

(10) RATIO/NORMAL Switch (S4) (Option 01 only): Selects the Model 3430A function; NORMAL selects voltage measurements (see Paragraph 3-13); RATIO selects voltage ratio measurements.

(11) + REF - Switch (S5) (Option 01 only): Selects polarity of ratio reference voltage (see Paragraph 3-13).

(12) REF INPUT (Option 01 only): The ratio reference voltage is applied to these two terminals (see Paragraph 3-13).

(13) AMPLIFIER OUTPUT: A 0 to ±15.99 volt dc output proportional to dc input.

(14) ZERO Adjustment: Sets the digital readout on the front panel for zero indication when input is shorted, or for zero with a known source resistance (see Paragraph 3-5e, note).

Figure 3-1. Front and Rear Panel Description

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The -hp- Model 3430A Digital Voltmeter measures dc voltages from ±100 mV full scale to ±1000 V full scale with accuracy of ±(0.1% of reading + 1 count) and overrange capability of 60%. The Model 3430A also functions as a ±0.1% dc amplifier with 5 gain ranges from + 40 dB to - 40 dB. With Option 01, the Model 3430A measures dc voltage ratios from 0.0001 to 1000:1. This section describes the procedures for operating the Model 3430A as a voltmeter, ratiometer, and amplifier.

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. Figure 3-1 shows the location of all the front and rear panel indicators and includes a brief description of each.

3-5. TURN-ON PROCEDURE.

a. Set the 115/230 slide switch (S3) to coincide with the line voltage used.

b. Connect power line to ac power connector. If instrument has Option 01, set RATIO/NORMAL switch to NORMAL position.

c. Switch LINE toggle switch upward, turning instrument on. Allow 10 minutes for instrument warmup.

d. Set the Model 3430A RANGE to 100 mV, and short input terminals. ⎓

e. Adjust rear panel ZERO control so that digital readout indicates all zeros and polarity indicator switches alternately between + and -.

NOTE

There may be a zero offset of a few counts between shorted input and open input on the 100 mV range. This is caused by a small leakage current flowing from the amplifier input through the input attenuator to ground. This offset does not affect the accuracy when measuring across a low source resistance (< 100 kΩ). However, when measuring across a source resistance greater than 100 kΩ, there may be a small error. This error can be eliminated by zeroing the Model 3430A with the source resistance connected across the input.

3-6. DC VOLTAGE MEASUREMENTS.

a. Turn Model 3430A on and zero it according to the steps in Paragraph 3-5.

b. Set RANGE switch to approximate range of input. If in doubt, select highest range, and downrange as necessary.

CAUTION

DO NOT APPLY VOLTAGE GREATER THAN 1000 V TO INPUT TERMINALS. DO NOT FLOAT ⏚ TERMINAL MORE THAN 500 V ABOVE GROUND (⏚).

c. Connect voltage to be measured to INPUT terminals. Connect high side of input to high (red) terminal and low side to ⏚ terminal. For floating measurement, disconnect shorting bar between ⏚ and ⏚ terminals. For a referenced measurement, leave shorting bar connected.

d. Read magnitude of applied voltage on front panel. Polarity is automatically indicated.

3-7. OVERRANGE OPERATION.

3-8. The Model 3430A can be operated with input signals 59.9% overrange on all ranges except the 1000 V range with no loss in accuracy. For example, 15.99 volts may be applied with the range switch in the 10 V position.

3-9. OVERLOAD INDICATION.

3-10. Any voltage in excess of 59.9% overrange will cause the Model 3430A to overload. This condition is indicated by a flashing display.

3-11. DC AMPLIFIER OPERATION.

3-12. The Model 3430A may be used as a dc amplifier with a ±0.1% gain accuracy. The gain depends on the range selection. The input is connected to the front panel INPUT terminals and the output is taken from the rear panel AMPLIFIER OUTPUT terminals. The dc amplifier output can also be used to drive a recorder while dc voltage measurements are being made.

a. Turn on and zero the Model 3430A according to Paragraph 3-5.

b. Select desired gain using RANGE switch. Table 3-1 shows the input voltage, output voltage, and gain for each RANGE selection.

Table 3-1. Amplifier Gain

Range	Input	Amplifier Output	Gain
100 mV	0 to ±159.9 mV	0 to ±15.99 V	40 dB
1000 mV	0 to ±1599 mV	0 to ±15.99 V	20 dB
10 V	0 to ±15.99 V	0 to ±15.99 V	0 dB
100 V	0 to ±159.9 V	0 to ±15.99 V	-20 dB
1000 V	0 to ±1000 V	0 to ±10.00 V	-40 dB

c. Connect the signal to be amplified to the INPUT terminals and the load to the AMPLIFIER OUTPUT terminals.

NOTE

The load resistance must be greater than 16 kΩ or the amplifier gain accuracy will not be within ±0.1% and the amplifier will not have full dynamic range.

3-13. RATIO OPERATION (Option 01 only).

3-14. Instruments with Option 01 have the capability of measuring voltage ratios. The following steps describe the procedure.

a. Turn on and zero the 3430A according to Paragraph 3-5.

b. Slide NORMAL/RATIO switch to RATIO position. RATIO indicator will light.

c. Apply a dc reference voltage of 0.80 to 1.20 volts between rear panel REF INPUT and ⏚ terminals.

d. Slide REF POLARITY switch to coincide with polarity of reference voltage with respect to circuit common (⏚). If REF POLARITY switch is in incorrect position, front panel display will flash.

e. Set range switch to appropriate range of input. If in doubt, select highest range and downrange as necessary.

f. Connect input signal.

3-15. The front panel displays will indicate the ratio of the input voltage to the reference voltage. On the 10 V, 100 V, and 1000 V ranges the "V" indicator will be lit. On the 100 mV and 1000 mV ranges the "MV" indicator will be lit, indicating that the ratio must be divided by 1000. For example, a ratio reading of 608 on the 1000 mV range would actually be a ratio of 0.608.

3-16. The reference voltage applied to the rear terminals must be 0.8 to 1.2 volts for operation at rated accuracy. If the reference voltage is greater than 1.00 V the maximum readout of 1599 counts cannot be achieved, and the maximum number of counts is equal to $\frac{1599}{\overline{V}_{reference}}$. When $V_{reference}$ is 1.2 volts, the maximum number of counts is 1333.

3-17. Usable ratio readings may be made with reference voltages as high as 1.3 volts or as low as 0.2 volts, but the accuracy is derated. Table 3-2 shows typical accuracies with reference voltages greater than 1.2 volts and less than 0.8 volts. The accuracy values are shown with equal reference and input voltages (ratio = 1.000).

Table 3-2. Typical Ratio Accuracy Variations

Reference Voltage	Accuracy
0.2 V	± (1.3% of reading + 1 count)
0.3 V	± (0.9% of reading + 1 count)
0.4 V	± (0.7% of reading + 1 count)
0.5 V	± (0.5% of reading + 1 count)
0.6 V	± (0.3% of reading + 1 count)
0.7 V	± (0.2% of reading + 1 count)
0.8 to 1.2 V	± (0.15% of reading + 1 count)
1.3 V	± (0.2% of reading + 1 count)

SECTION IV
THEORY OF OPERATION

4-1. GENERAL.

4-2. The Model 3430A makes voltage measurements by comparing the input voltage to an internally generated "staircase ramp" voltage. When the input and the staircase ramp voltages are equal, a comparator generates a signal to stop the ramp. Then the instrument displays the number of steps necessary to make the staircase ramp equal to the input. At the end of the sample, a reset pulse resets the staircase to zero and the measurement starts over. The display circuits store each reading until a new reading is completed, eliminating any blinking or counting during computation. The sample rate is fixed at two samples per second. Figure 4-1 shows the relationship between the staircase ramp and the input signal.

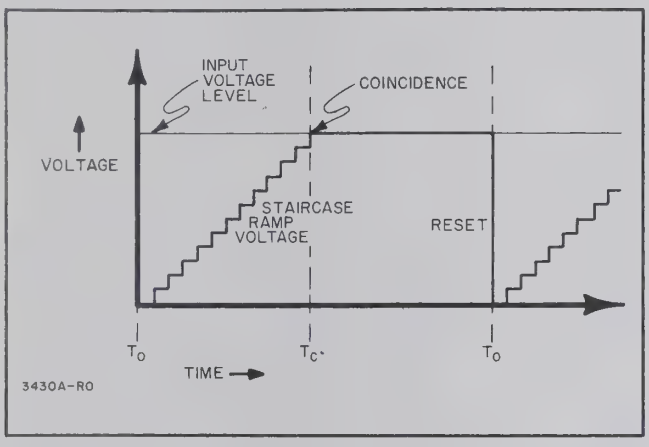


Figure 4-1. Relationship Between the Staircase Ramp and Input Signal

4-3. BLOCK DIAGRAM ANALYSIS. (Fig. 7-2)

4-4. The Staircase Ramp circuits include a 4.5 kHz oscillator, decade counter circuits, and digital-to-analog (D/A) converters. The counter circuit counts the pulses from the 4.5 kHz oscillator, and the output of the counter is a binary number equal to the total number of oscillator pulses. The D/A converters convert the binary numbers from the counter to equivalent analog voltages. Thus, each pulse from the oscillator causes one count increase in the counter output, making the D/A converter output increase by a fixed amount. As long as the oscillator continues to run, the converter output increases incrementally, producing a "staircase" ramp voltage. The staircase ramp from the D/A converter is applied to the Staircase Amplifier, the gain of the staircase amplifier is adjusted to calibrate the ramp. The comparator flip-flop controls the staircase ramp by turning the 4.5 kHz oscillator on and off.

4-5. The input signal passes through the input attenuator to the input amplifier where it is amplified by a factor of 100. The attenuator output is 0 to ± 100 mV full scale on all ranges, so the amplifier output is 0 to ±10 V full scale, and 0 to ±15.99 V with overrange. The rear panel AMPLIFIER OUTPUT is the output of the input amplifier.

4-6. The comparator input is a resistive summing junction. The staircase voltage is positive, and the input voltage connected to the comparator is negative. The polarity amplifier detects the polarity of the signal from the input amplifier and controls the polarity flip-flop and A1K1. If the input is positive A1K1 is de-energized, connecting the inverter amplifier so that the input to the comparator will be negative. However, if the input is negative, A1K1 is energized, and the negative input is connected directly to the comparator. The polarity flip-flop also operates the front panel polarity indicators.

4-7. The 2 Hz sample oscillator controls the sampling of the Model 3430A. Its output is a 100 ms timing pulse occurring two times per second. The timing pulse drives the transfer amplifier to produce the transfer pulse, and the trailing edge of the transfer pulse triggers the reset amplifier, producing the reset pulse. The transfer pulse transfers the number stored in the counters to the readout at the end of each sample. The reset pulse ends the measurement sample and initiates a new sample.

4-8. At T_o the reset pulse resets the decade counters to zero and sets the comparator flip-flop to allow the 4.5 kHz oscillator to run, starting the staircase ramp. The ramp increases until it equals the input. When the ramp and the input are equal (T_c) the comparator output changes the state of the comparator flip-flop, stopping the oscillator and the ramp. At T_t, about 400 ms from the start of the sample, the transfer pulse transfers the stored count from decade counters to the digital display tubes. The reset pulse occurs at the trailing edge of transfer pulse, initiating a new sample.

4-9. INPUT ATTENUATOR.

4-10. The input attenuator A6 (see Figure 7-8) is a series voltage divider with a total resistance of 10 MΩ. It provides five ranges from 100 mV full scale to 1000 V full scale, and its output is 0 to ±100 mV full scale on all ranges. With a 60% overrange input, the attenuator output is ±159.9 mV. A6R4, R6, R9 and R12 are adjusted to calibrate the attenuator. A6R3* is selected to adjust the total resistance. Resistors A6R1, R7, R10 and R13 set the attenuator's output resistance at 900 kΩ on all ranges.

4-11. INPUT AMPLIFIER AND INVERTER AMPLIFIER.

4-12. The input amplifier is a feedback-stabilized dc amplifier with a gain of 100. The input stage is a differential amplifier made up of two matched field-effect transistors (A1Q1A and A1Q1B) enclosed in the same container. R4 and A1R84 adjust the balance of the input stage and act as zero controls for the amplifier. A1R84 is a coarse zero adjustment, and R4 is a fine adjustment. A1Q2 supplies a constant current to the differential amplifier to ensure linearity and stability. The output of the first stage is connected to another differential amplifier (A1Q3 and A1Q4) and then to emitter follower stage A1Q5. The signal from the emitter of A1Q5 drives A1Q6, the output stage.

4-13. In a feedback amplifier such as the input amplifier, the overall gain is inversely proportional to the amount of feedback, and if the open-loop gain of the amplifier is quite high, the gain is equal to the reciprocal of the feedback ratio. For example, if half of the output were fed back, the feedback ratio would be 1/2, and the gain would be 2. In the Model 3430A input amplifier, the output from the collector of A1Q6 is fed back to the gate of A1Q1B as shown by the heavy dotted line in Figure 7-3. A1R6, A1R7 and A1R9 form a series voltage divider, and the voltage across A1R6 and 7 is applied to the gate of A1Q1B. Since the voltage across A1R6 and 7 is 1/100 of the total output, the gain is 100. A1R7 is adjusted to set the gain at exactly 100.

4-14. Superimposed ac signals on the amplifier output are shunted around A1R9 by A1C3 and A1R71. Consequently, more of the ac signal is fed back, reducing the ac gain and improving the ac rejection of the amplifier. A pi type input filter (A1R2, A1C1 and A1C2) provides additional ac noise rejection.

4-15. The inverter amplifier is a unity gain operational amplifier. In this type of amplifier, the inverted output is fed back to the input for gain stabilization, and the gain is equal to the ratio of the feedback resistance to the input resistance. The input resistance (A1R15) and the feedback resistance (A1R14 and A1R16) are equal, so the gain is one. A1R14 is selected to set the gain at exactly one.

4-16. POLARITY CIRCUITS.

4-17. The polarity amplifier and polarity flip-flop detect the polarity of the input signal and control A1K1 to switch the inverter amplifier in and out. A positive input de-energizes A1K1 and connects the inverter amplifier. A negative input energizes A1K1 and disconnects the inverter.

4-18. A positive input to the polarity amplifier causes a negative output. The negative output at the collector of A1Q23 turns A1Q24 on and A1Q25 off. In this state, the + indicator, DS6, is illuminated and A1K1 is de-energized. With a negative input the polarity amplifier output is positive, turning A1Q24 off and A1Q25 on. In this state, the - indicator, DS7, is illuminated, and A1K1 is energized.

4-19. COMPARATOR CIRCUITS.

4-20. The comparator is a high gain amplifier that compares the staircase with the input voltage. The input stage, A1Q13A and A1Q13B, is a differential amplifier. The staircase is applied through A1R31 to the base of A1Q13A, and the input voltage is applied through A1R30 to the base of A1Q13A. The staircase voltage is positive, and the input is negative. Before coincidence the voltage at the base of A1Q13A is negative, and as the staircase approaches the input the base voltage approaches zero. When the staircase becomes just slightly larger than the input, the base of A1Q13A becomes slightly positive; and the comparator saturates, triggering the comparator flip-flop.

4-21. The comparator flip-flop (A1Q16 and A1Q17) is a bistable circuit that controls the 4.5 kHz oscillator. At T_o, A1Q16 is cut off and A1Q17 is on, starting the 4.5 kHz oscillator. At T_c, the negative output from the comparator turns on A1Q16, changing the state of the comparator flip-flop. The negative output from the collector of A1Q17 stops the 4.5 kHz oscillator. At T_o, the reset pulse resets the comparator flip-flop to its original state.

4-22. 4.5 KHZ OSCILLATOR AND COUNT GATE.

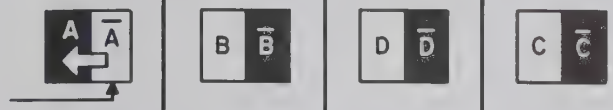
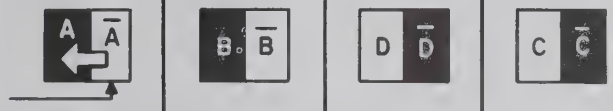
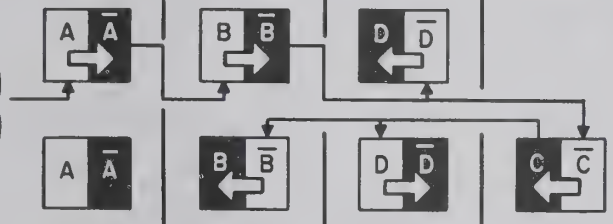
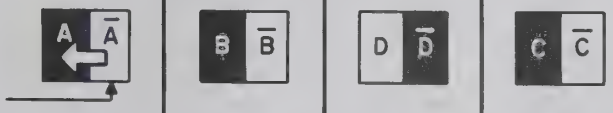
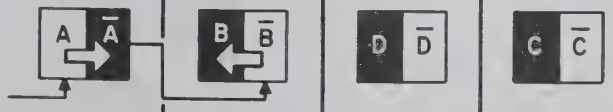
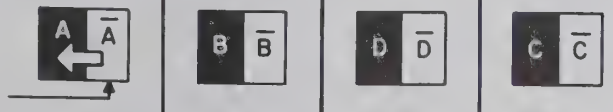
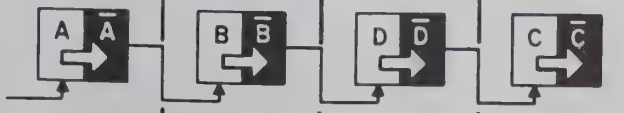
4-23. The 4.5 kHz oscillator is a relaxation oscillator. A1R27, A1R28, and A1R29 form a voltage divider, and the voltage across A1R29 is about -10 V, keeping A1Q8 and A1Q9 cut off. Capacitor A1C8 charges toward -30 V, and when its charge reaches about 11 volts, A1Q8 and A1Q9 turn on, discharging A1C8. When A1C8 is discharged, A1Q8 and A1Q9 are again reverse biased and A1C8 begins to recharge toward -30 V. This cycle continues, resulting in a 4.5 kHz non-symmetrical square wave at the collector of A1Q8. The frequency of oscillation is primarily determined by the RC time constant of A1C8 and A1R26.

4-24. The count gate, A1Q7, controls the 4.5 kHz oscillator. When A1Q7 is on, it shorts A1C8, preventing the oscillator from operating. When A1Q7 is cut off, it has no effect on the oscillator. At T_c, the negative output from A1Q7 in the comparator flip-flop turns A1Q7 on, stopping the oscillator.

4-25. DECADE COUNTER CIRCUITS.

4-26. The decade counters count the pulses from the 4.5 kHz oscillator and generate a binary coded decimal number equal to the total number of pulses. Figure 4-2 shows a block diagram of a typical decade counter. The counters each contain four binaries connected in series. Each binary is a bistable multivibrator connected to change state with each input pulse. Binary A will change state with each pulse from the oscillator; binaries B through D will follow the switching sequence shown in Table 4-1. Each input pulse will cause a unique combination of outputs. There are ten such combinations and each one represents a decimal digit.

Table 4-1. Counter Switching Sequence

DECIMAL COUNT	COUNTER STATE (■ CONDUCTION) WEIGHTING A = 1, B = 2, D = 4, C = 2	4-LINE CODE D	C	B	A
0		0	0	0	0
1		0	0	0	1
2		0	0	1	0
3		0	0	1	1
4		0	1	1	0
5		0	1	1	1
6		1	1	0	0
7		1	1	0	1
8		1	1	1	0
9		1	1	1	1
0		0	0	0	0

05212-C-1

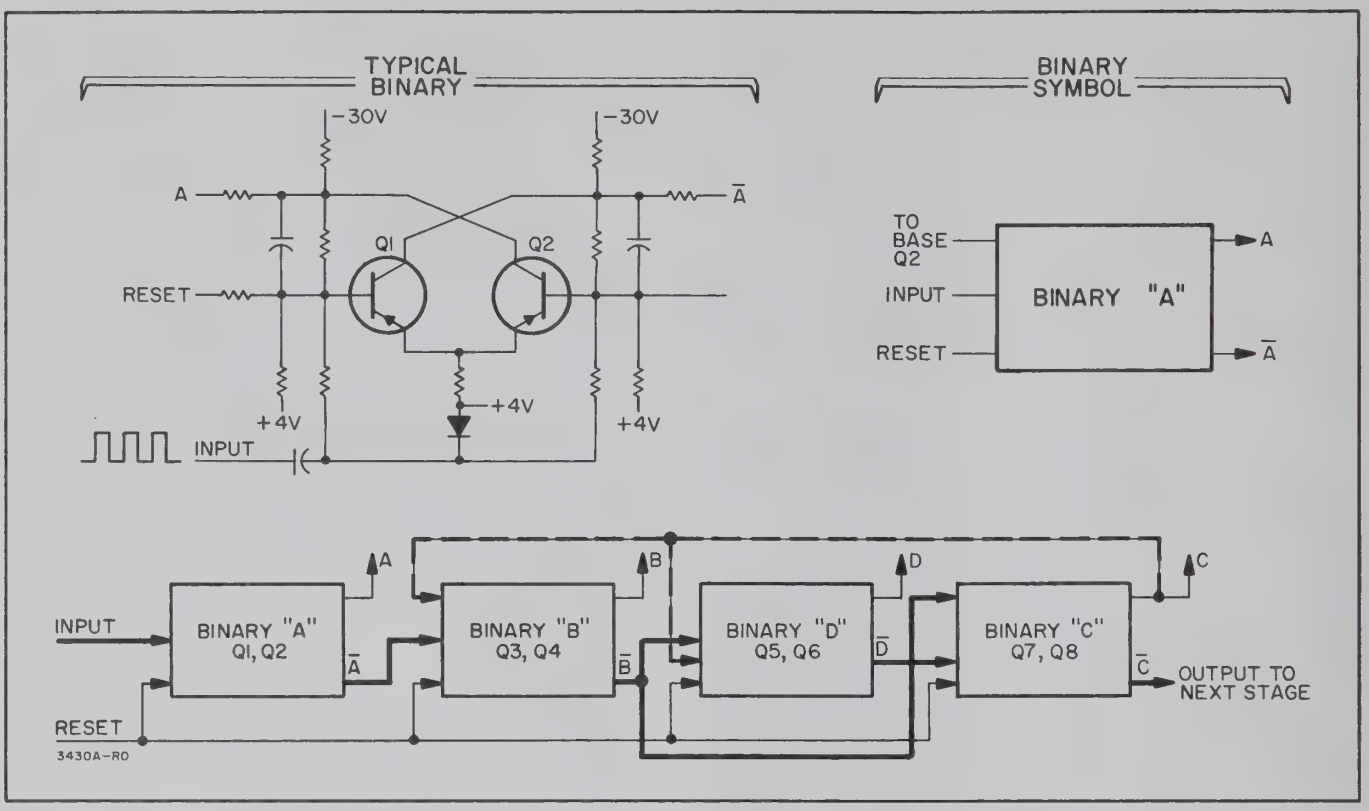


Figure 4-2. Decade Counter Circuit

4-27. A given binary, A for example, has two states, A and $\overline{A}$. (See typical binary in Figure 4-2.) When the A transistor is conducting the binary is in the A state, and when the $\overline{A}$ transistor is conducting the binary is in the $\overline{A}$ state. A is called the "true" state and $\overline{A}$ the "false" state.

4-28. A true binary represents a decimal number. (A = 1, B = 2, C = 2, and D = 4.) A false binary represents zero. The decimal number represented by the decade counter is the sum of the numbers represented by each binary. For example, if binary A is true, B is true, D is false, and C is true; the number represented is 1 + 2 + 0 + 2 = 5.

4-29. Table 4-1 shows the counting sequence. The arrow in each block shows the direction the binary has switched. Initially each binary is set to the false state by the reset pulse (DCBA = 0000). The following action takes place when a series of pulses is applied to the counter:

a. The first pulse switches A to the "1" (true) state.

b. The second pulse switches A to the "0" (false) state, and the output from A switches to B to the "1" (true) state. (DCBA = 0010 = 2.)

c. The third pulse switches A to the "1" state. (DCBA = 0011 = 3.)

d. The fourth pulse switches A to the "0" state; the output from $\overline{A}$ changes B to the "0" state; the output from $\overline{B}$ changes D and C to the "1" state. The resulting signal from C is applied to $\overline{B}$ and D to return B to the "1" state and D to the "0" state. Although $\overline{D}$ is connected to C, no switching occurs at C because C has not recovered from its recent switching. (DCBA = 0110 = 4.)

e. The fifth pulse switches A to the "1" state. (DCBA = 0111 = 5.)

f. The sixth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "0" state; the output from $\overline{B}$ switches D to the "1" state. (DCBA = 1100 = 6.)

g. The seventh pulse switches A to the "1" state. (DCBA = 1101 = 7.)

h. The eighth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "1" state. (DCBA = 1110 = 8.)

i. The ninth pulse switches A to the "1" state. (DCBA = 1111 = 9.)

j. The tenth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "0" state; the output from $\overline{B}$ switches D to the "0" state; the output from $\overline{D}$ switches C to the "0" state; (DCBA = 0000.) When C becomes "0", C produces an output pulse which serves as a carry pulse to the next counter. The counter is now in its original state.

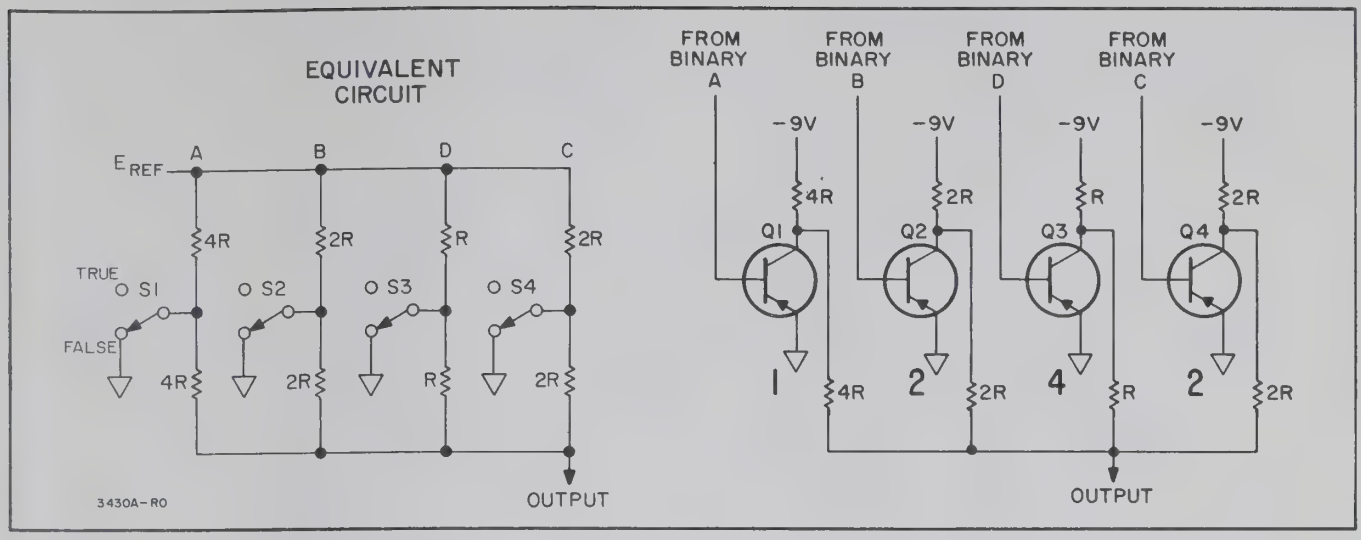


Figure 4-3. D/A Converter Circuit

4-30. D/A CONVERTERS.

4-31. The D/A converters convert the binary numbers represented by the counters to an equivalent current. Thus, each pulse into the counters causes the number represented to increase by one, and causes the current out of the converters to increase by one increment. The staircase amplifier converts the current from D/A converters to a proportional voltage, producing the staircase ramp.

4-32. Figure 4-3 contains an equivalent circuit of a D/A converter. Switches S1 through S4 are operated by binaries A, B, D, and C respectively. When the binaries are false, the switches are switched to ground as shown; when the binaries are true, they are switched to the opposite position. When binary A is true, current flows from E ref to the output through circuit A. This current is equivalent to a 1 in the counter. When binary B is true, current flows through circuit B to the output. The current through circuit B is twice as much as the current through circuit A, and this current represents a 2. When D is true, four times as much current flows to the output, representing a 4. When C is true, the current output represents a 2. The current output from the D/A will be proportional to the number in the counter.

4-33. Also shown in Figure 4-3 is the circuit used in the units and tens D/A converters. The switches are replaced by switching transistors. A false output from binary A would turn Q1 on, clamping its collector to ground. A true output would keep Q1 cut off, allowing a current path from the -9 V reference through the two 4R resistors to the output. This current represents a 1. Transistors Q2 through Q4 are controlled by binaries B, D, and C respectively.

4-34. The hundreds D/A circuits operate in a similar manner; however, the transistor switches operate in the inverted mode. That is, the transistor is turned on by the bias on the base-collector junction, rather than the base-emitter junction. When operated in the inverted mode, the switching resistance of the transistor is very low. This is necessary in the hundreds D/A circuits so that switching resistance does not affect the D/A output current. Figure 4-4a shows a typical D/A converter circuit when the associated binary is in the false state. Both the base-emitter and base-collector junctions of Q1 are reverse biased, so Q1 is off. The base-collector junction of Q2 is forward biased, so Q2 is turned on. The switching current, I_{SW}, flows through R_B and Q2 to ground. Since the output to the staircase amplifier is at a virtual ground (operational amplifier input), and because $R_{D/A}$ is a relatively high value, the current through $R_{D/A}$ to the staircase amplifier will be insignificant.

4-35. Figure 4-4b shows conditions when the binary is in the true state. Both junctions of Q2 are now reversed biased, so Q2 is turned off. The base-collector junction of Q1 is now forward biased, turning Q1 on. The switching current now flows from the -9 V reference supply through Q1 and R_B, which could cause excessive loading of the reference supply. Q3 is on at the same time Q1 is on, thus providing a source of compensating current to offset the switching current. Since I_{SW} is approximately three times as much as the D/A current $I_{D/A}$, the sum of the compensating current, I_{COMP}, and $I_{D/A}$ should equal I_{SW}.

4-36. To provide the 60% overranging capability of the 3430A, an overrange binary has been included in the hundreds decade counter (see Figure 7-4). When binary C changes from true to false, overrange binary E changes to the true state. This changes the state of the overrange flip-flop, lighting DS8, which is the overrange "1" indicator in the front panel display. Binary E, in the true state, also turns on its associated D/A circuit, and is coupled to the binary D D/A circuit, holding this circuit on, but allowing the binary and readout to reset to zero. Since the binary D D/A current has a weight of 4, and the binary E D/A current has a weight of 6, this provides an output of 10 from the hundreds decade to the staircase amplifier. Because the binary D D/A circuit is held on by the overrange binary, the hundreds decade may now count only five additional counts. This allows a maximum front panel reading of 1599.

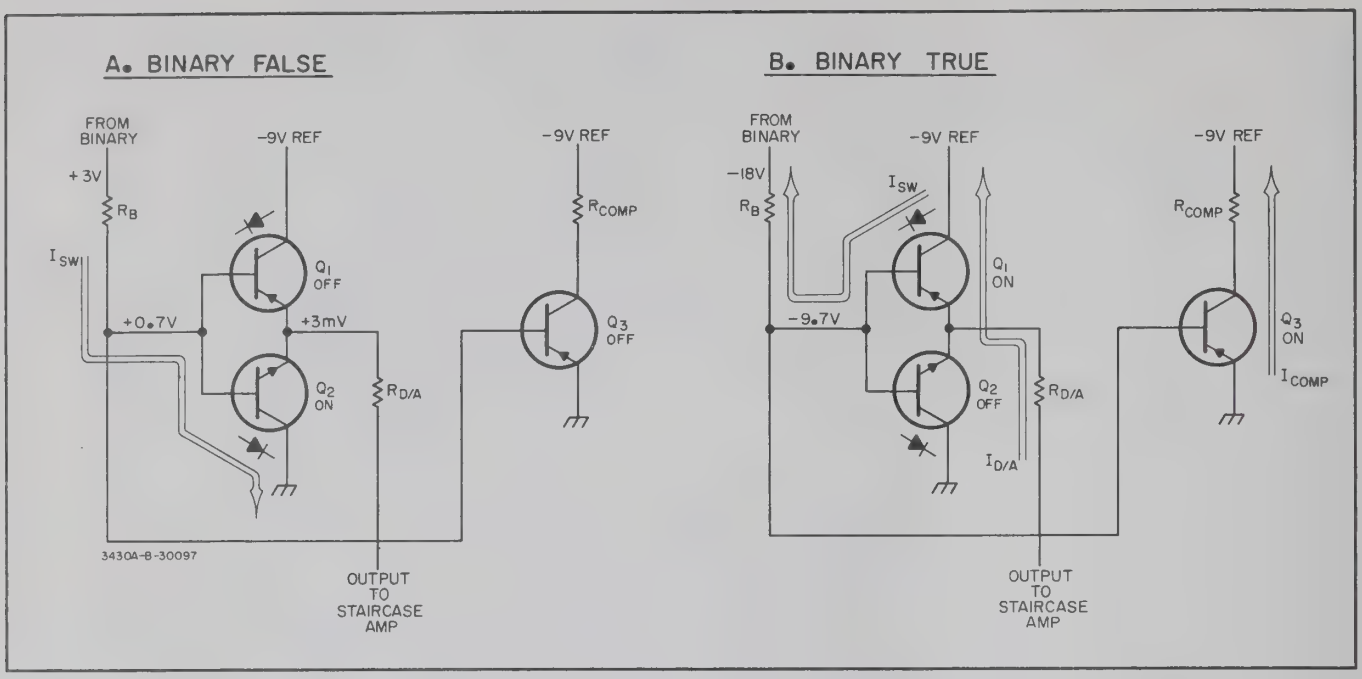


Figure 4-4. Typical Hundreds Decade D/A Circuit

4-37. STAIRCASE AMPLIFIER.

4-38. The Staircase Amplifier converts the current from the D/A converters to a proportional voltage, producing the staircase ramp. It is an operational amplifier similar to the inverter amplifier. Its gain is adjusted by A1R51 so that a full scale staircase current will produce a + 10.000 volt output. A1R50* in the feedback circuit is selected to bring the gain adjustment into the range of A1R51.

4-39. DISPLAY AND STORAGE CIRCUITS.

4-40. The binary coded outputs of the counters control neon lamps. The lamps activate a photoconductor matrix which is connected to the display tube. A lighted photoconductor element has a resistance of about 20,000 ohms, and an unlighted element has a resistance of several megohms. Each binary coded decimal output yields a unique low resistance path through the matrix. There are ten such paths, and each is connected to a digit in the display tube.

4-41. Two lamps are connected to each binary, one to each collector. The lamp in the conducting collector is lit, and the one in the non-conducting collector is extinguished (see Figure 4-5a). Ordinarily, the lamps would reverse every time the binary switched, and the readout would flicker during the counting and resetting process. However, two diodes are connected between the lamps so that the lamps can only change state when the diodes are properly biased (see Figure 4-5b). This prevents flickering in the readout.

4-42. First consider the circuit without the diodes connected (Figure 4-5a). Lamp A is lighted, and lamp $\overline{A}$ is dark. Since transistor A is not conducting, the voltage across lamp A is established by both the circuit of conducting lamp A and the collector voltage of transistor $\overline{A}$. This voltage is typically 38 V, much lower than the lamp's firing potential of 70 V. So lamp $\overline{A}$ cannot fire.

4-43. When the binary changes state, the transistor $\overline{A}$ collector voltage drops to -1 volt, and the collector of transistor A rises to -23 volts. When transistor A cut off, the voltage at the junction of the two lamps increases to about 70 volts and lamp $\overline{A}$ fires. Lamp A has -23 volts on one side and -70 volts on the other, and is extinguished.

4-44. When the diodes are connected as shown in Figure 4-5b, the switching of the lamps can be stopped. With +4 volts applied, both diodes are forward biased, clamping the bottom side of both neons to +4 volts. The voltage across the extinguished neon is now held at the sustaining voltage of the lighted neon, and the lamps cannot change state.

4-45. At T_t, the -30 volt transfer pulse is applied to the diodes, reverse biasing them. The diodes are now effectively removed from the circuit and the lamps change to the state of the binary. At T_0, the transfer pulse is removed, and the lamps remain in that state until a new reading is transferred.

4-46. TIMING CIRCUITS.

4-47. The 2 Hz oscillator is a relaxation oscillator similar to the 4.5 kHz oscillator. Its output is a 2 Hz, negative going, 100 ms pulse that is applied to the base of A1Q28, the transfer amplifier. The output from the emitter of A1Q28 is the transfer pulse shown in Figure 7-2. The transfer pulse goes to the decade counter assemblies and is also applied to the reset amplifier. A1C13, A1R78, and A1R79 in the base circuit of A1Q29 differentiate the transfer pulse. The spike from the leading edge does not affect A1Q29, but the positive spike from the trailing edge turns on

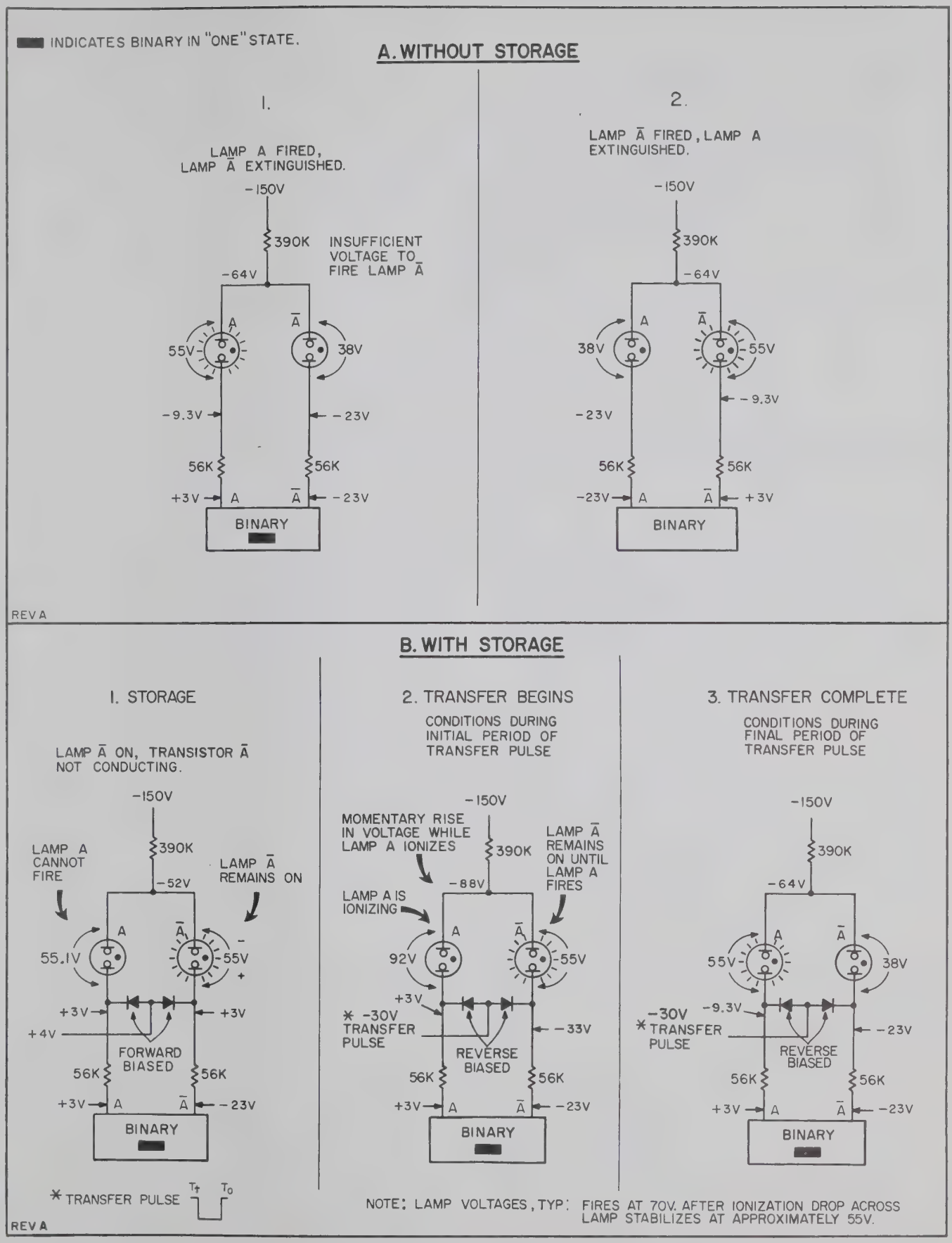


Figure 4-5. Storage Circuits

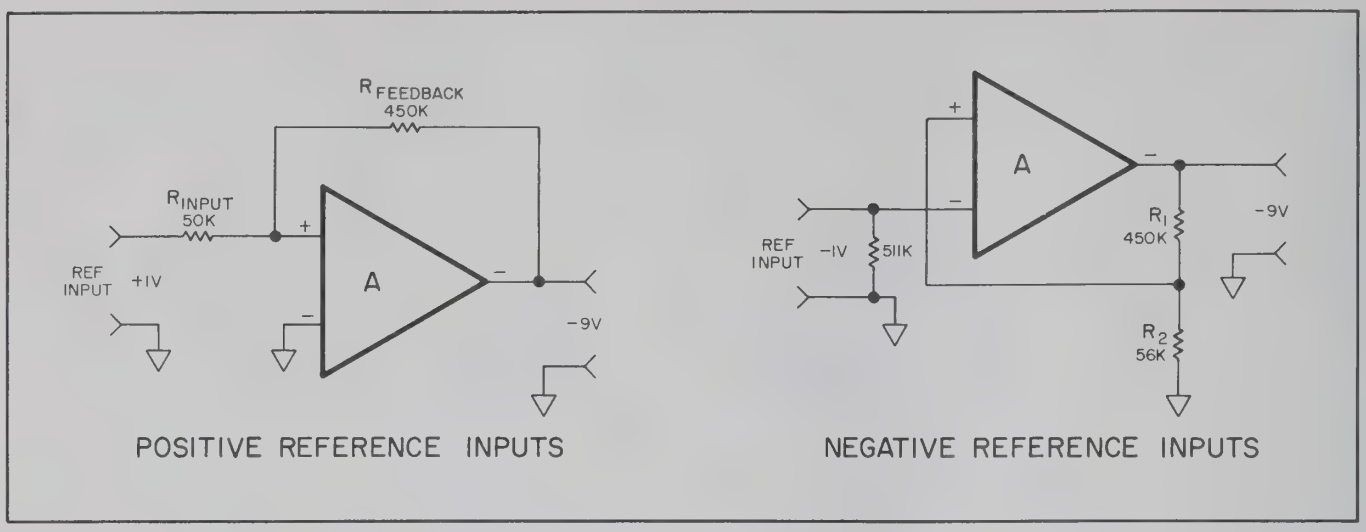


Figure 4-6. Ratio Reference Amp

A1Q29 to generate the reset pulse. Thus, the reset pulse occurs at the trailing edge of the transfer pulse, the end of the sample.

4-48. RATIO OPTION.

4-49. In the ratio mode of operation, the output of the reference amplifier replaces the internal - 9 V reference to the D/A circuits. Figure 4-6 shows simplified diagrams of the reference amplifier for positive and negative reference inputs. When a positive reference input is used, the reference amplifier is connected as an inverting operational amplifier with a gain of 9, where

$$\text{Gain} = \frac{R_{feedback}}{R_{input}}$$

When the reference input is negative, the reference amplifier is used as a non-inverting voltage amplifier, also having a gain of 9, where Gain = R1 + R2/R2. The front panel display will indicate the ratio of the input voltage to the reference voltage.

Table 5-1. Test Equipment Required

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DC Standard	Voltage Range: 0 - 1000 volts Accuracy: ±0.02% of setting ±10 μV	-hp- Model 741B AC/DC Differential Voltmeter/ DC Standard
DC Voltmeter	Range: 0 - 1000 V Accuracy: ±0.01% or better	-hp- Model 3420A/B Differential Voltmeter/ Ratiometer or -hp- Model 3460A Digital Voltmeter
DC Voltmeter	Range: 0 - 300 V Accuracy: ±2%	-hp- Model 427A Voltmeter
Oscilloscope	Bandwidth: to 450 kHz Sensitivity: 10 mV/cm	-hp- Model 120B Oscilloscope
Variable Transformer	Output Voltage: 103 to 127 Vac (or 207 to 253 Vac)	Superior Electric Co. Powerstat 3PF116 (for 115 V line) 3PF216 (for 230 V line)
Capacitor	0.82 μF ±10% mylar	-hp- Part No. 0160-0321
Resistor	1.0 MΩ ±0.1% 1/8 W	-hp- Part No. 0811-0473
Resistor	400 kΩ ±0.02% 1/8 W	Use four -hp- Part No. 0811-0191, 100 kΩ resistors
Resistor	33 kΩ ±10% 1/4 W	-hp- Part No. 0684-3331
Resistor	600 Ω ±1% 1/4 W	-hp- Part No. 0698-5405 -hp- Part No. 5060-0630
Oscillator	Frequency Range: 100 Hz Output: > 10 V rms	-hp- Model 200 CD Wide Range Oscillator
AC Voltmeter	Range: 0 - 10 V Frequency Range: 0 - 100 Hz Accuracy: ±3%	-hp- Model 403A AC Transistor Voltmeter

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary to maintain the Model 3430A. The following paragraphs describe the Performance Checks, the Calibration Procedures and the Troubleshooting Procedures.

5-3. REQUIRED TEST EQUIPMENT.

5-4. Recommended test equipment for maintaining and checking performance of the Model 3430A is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

5-5. PERFORMANCE CHECKS.

5-6. Use the following front and rear panel procedures to verify proper operation of the Model 3430A. The Model 3430A and test equipment should be operated at 115/230 Vac unless otherwise specified. A Performance Check Test Card is provided at the end of this section for recording the performance of the 3430A. The card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. If the Model 3430A is found to be out of specifications at any point in this procedure, refer to Paragraph 5-15, Adjustment and Calibration procedure.

5-7. ACCURACY CHECK.

a. Connect the Model 3430A to a variable line transformer.

b. Set line voltage switch to 115 or 230 Vac, and turn the 3430A on with the line switch.

c. Allow the 3430A to warm up for at least 10 minutes.

d. Short the INPUT terminals, and set RANGE switch to 10 V. See 3-5

e. Adjust the rear panel ZERO control for a front panel indication of 0.00 V. Optimum adjustment is indicated by alternate flashing of (+) and (-) indicators.

f. Remove shorting connection from input.

g. Connect the standard as shown in Figure 5-1, and set the dc standard output to 1.000 volts. The 3430A indication should be between 0.99 V and 1.01 V.

h. Repeat step g for the values shown in Table 5-2. Then repeat the entire test on the 100 mV, 1000 mV, 100 V, and 1000 V ranges. The values shown in Table 5-2 may be used on the 100 mV, 1000 mV, 100 V and 1000 V test by moving the decimal point 1 or 2 places to the right or left. For the 1000 V test, do not exceed 1000 V input.

i. Repeat step h with negative voltages up to 500, removing input grounding strap on 3430A. Do not apply negative voltages greater than - 500 volts.

j. Repeat steps h and i with line voltages of 103 and 127 Vac (207 and 253 Vac with 230 Vac operation).

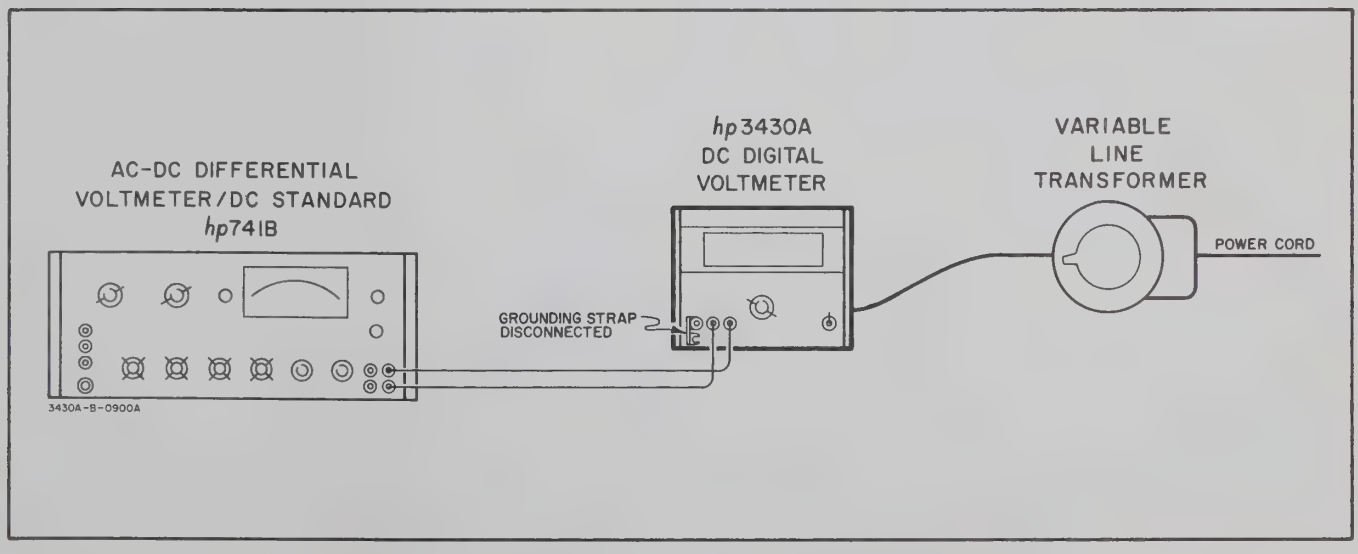


Figure 5-1. Accuracy Check

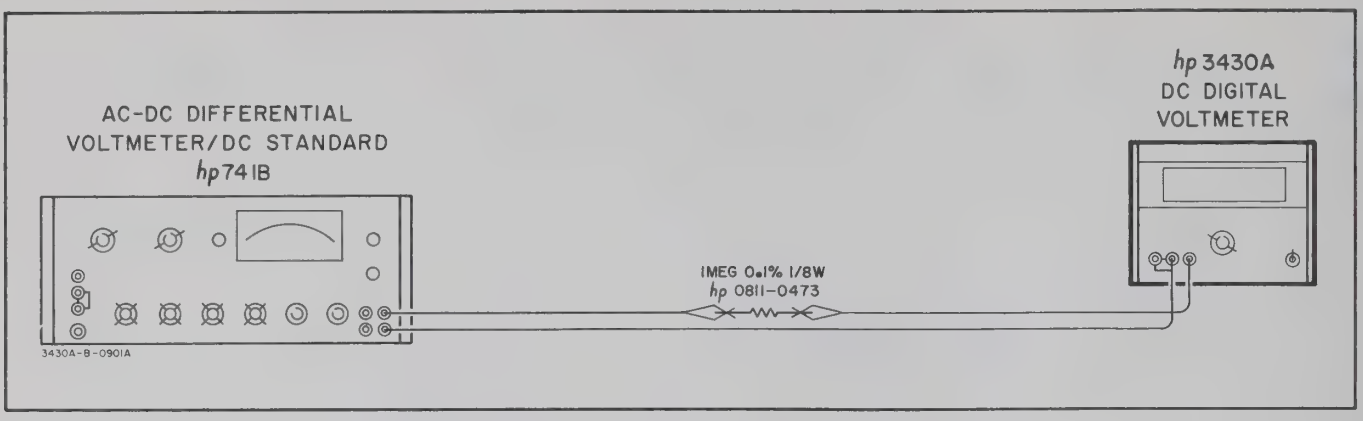


Figure 5-2. Input Resistance Check

Table 5-2. Calibration

	Model 3430A	
DC STANDARD	MINIMUM	MAXIMUM
0.00	- 0.01	+ 0.01
+ 1.00	+ 0.99	+ 1.01
+ 2.00	+ 1.99	+ 2.01
+ 3.00	+ 2.99	+ 3.01
+ 4.00	+ 3.99	+ 4.01
+ 5.00	+ 4.98	+ 5.02
+ 6.00	+ 5.98	+ 6.02
+ 7.00	+ 6.98	+ 7.02
+ 8.00	+ 7.98	+ 8.02
+ 9.00	+ 8.98	+ 9.02
+ 10.00	+ 9.98	+ 10.02
+ 11.00	+ 10.98	+ 11.02
+ 12.00	+ 11.98	+ 12.02
+ 13.00	+ 12.98	+ 13.02
+ 14.00	+ 13.98	+ 14.02
+ 15.00	+ 14.97	+ 15.02
+ 15.90	+ 15.87	+ 15.93

5-8. INPUT RESISTANCE CHECK.

a. Connect 3430A as shown in Figure 5-2. The 1 MΩ resistor (-hp- Part No. 0811-0473) and the 3430A input resistance form a series voltage divider.

b. Set RANGE switch to 10 V.

c. Set dc standard output to 10.00 volts.

d. The 3430A readout should indicate between 9.05 and 9.12. This corresponds to an input resistance of 9.7 to 10.3 MΩ where

$$R_{input} = \frac{E_{displayed}}{E_{input} - E_{displayed}} R_{series}$$

R_{series} is 1 MΩ in this test.

5-9. OVERLOAD INDICATION CHECK.

a. Connect the dc standard (-hp- Model 741B) to the 3430A INPUT.

b. Set the 3430A RANGE to 10 V. Set the dc standard to 15.0 volts.

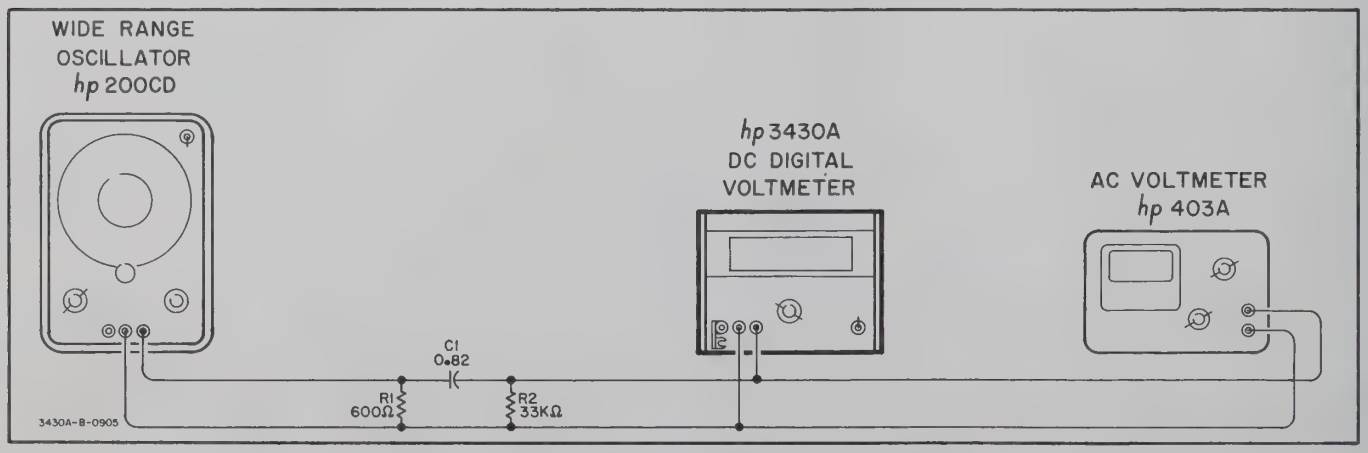


Figure 5-3. AC Superimposed Noise Check

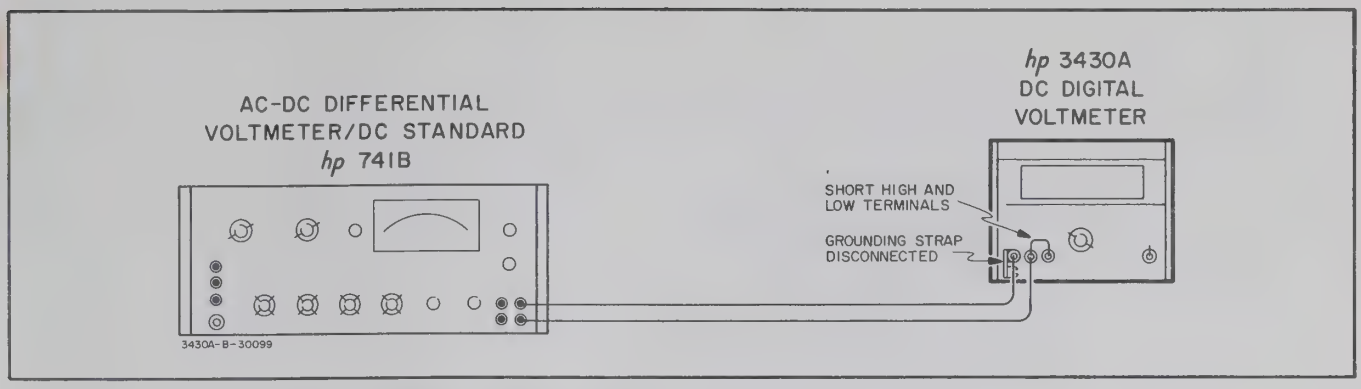


Figure 5-4. DC Common Mode Rejection Check

c. Gradually increase the dc standard voltage. The 3430A should indicate accurate voltages up to 15.99 volts. Input voltages above 15.99 volts should cause the display to flash, indicating overload condition. With a 1 count overload, the 3430A may indicate 19.99. This is normal.

5-10. AC SUPERIMPOSED NOISE REJECTION CHECK.

5-11. Figure 5-3 shows the AC Superimposed Noise Rejection Check. R1 is a 600 Ω load for the test oscillator. C3 blocks any dc from the oscillator output, and R2 provides a low source resistance for the 3430A input circuits.

a. Connect the 3430A as shown in Figure 5-3.

b. Zero the 3430A and set RANGE to 10 V.

c. Set oscillator frequency to 60 Hz. Using the ac voltmeter as a monitor, set test oscillator output to 1 V rms.

d. The 3430A reading should not change by more than ±2 digits.

5-12. DC COMMON MODE REJECTION CHECK.

a. Connect the 3430A as shown in Figure 5-4.

b. Zero the 3430A and set RANGE to 100 mV.

c. Set dc standard output to + 10 V.

d. The 3430A reading should not change more than ±3 digits.

5-13. AC COMMON MODE REJECTION CHECK.

a. Connect the 3430A as shown in Figure 5-5.

b. Zero the 3430A and set RANGE to 100 mV.

c. Set test oscillator to 60 Hz. Using the ac voltmeter as a monitor, set oscillator output to 7.07 V rms (10 V peak voltage).

d. The 3430A reading should not change more than ±3 digits.

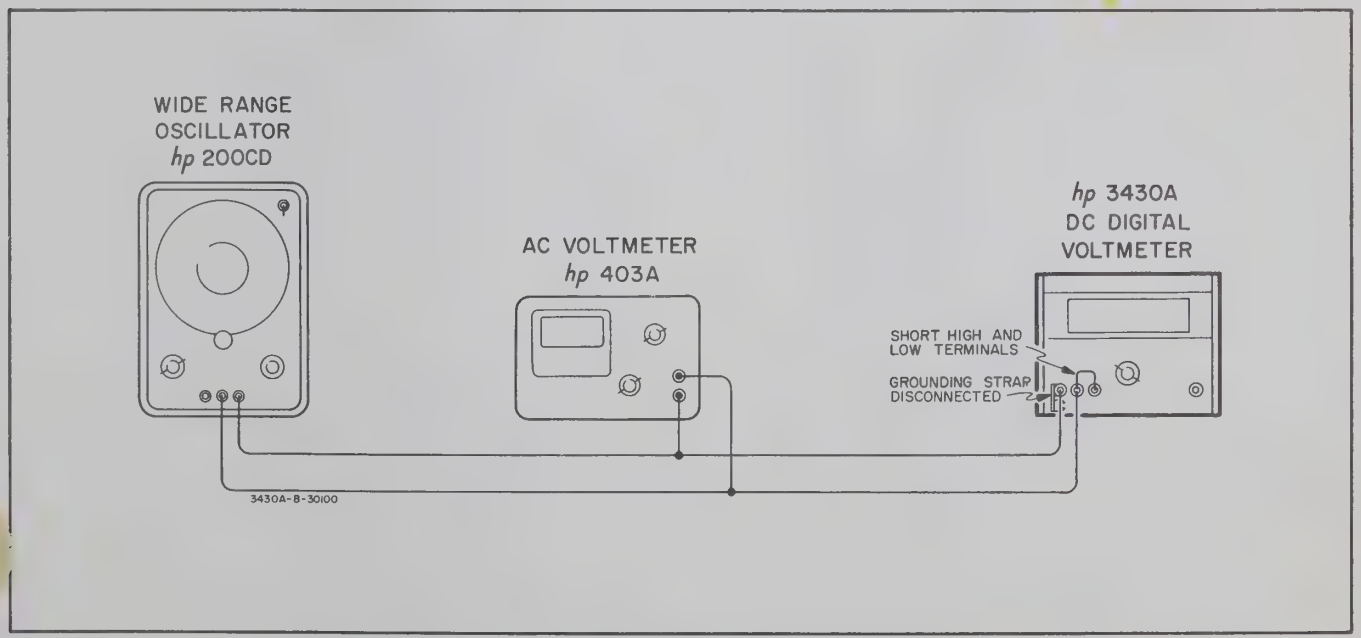


Figure 5-5. AC Common Mode Rejection Check

5-14. RATIO ACCURACY CHECK (Option 01 Only).

a. Set 3430A to 1000 mV scale and set the dc standard (-hp- Model 741B) to 0.80 volts. Set rear panel RATIO/NORMAL switch to RATIO.

b. Connect dc standard voltage to the 3430A front panel INPUT and rear panel REF INPUT. (See Figure 5-6.) This places the rear panel REF INPUT and front panel INPUT voltages in parallel, so the input ratio is 1.000.

c. Gradually increase the dc standard voltage from 0.80 to 1.20 volts. The 3430A digital display should read on or between 1003 mV and 997 mV.

d. Disconnect 3430A ground strap.

e. Position rear panel - REF + Switch to - (negative).

f. Repeat steps a through c of this paragraph with negative voltages.

g. The range attenuator and input amplifier determine the range accuracy and linearity of ratio measurements. Since the attenuator and input amplifier were checked by the DC Accuracy Check (Paragraph 5-7), the above ratio check is sufficient.

5-15. ADJUSTMENT AND CALIBRATION PROCEDURE.

5-16. The following test and adjustment procedures should be performed only if it has been definitely determined by the Performance Checks given in Paragraphs 5-5 through 5-14 that the Model 3430A is out of specifications. Figure 5-7 shows the location of internal adjustments.

NOTE

All voltage measurements made in this section are reference to circuit ground (⏚). The front panel INPUT terminal marked ⏚ and A1TP5 are circuit ground.

5-17. COVER REMOVAL.

a. To remove the top or bottom covers, remove the two Phillips screws at the rear of the cover, slide the cover about 1 inch to the rear, and lift off.

b. To remove the side covers, remove the four Phillips screws on each cover and lift off.

c. To replace covers, reverse the removal procedure.

5-18. POWER SUPPLY (A5 ASSEMBLY) ADJUSTMENT.

a. Supply the Model 3430A with primary power and turn LINE switch on.

b. Connect dc differential voltmeter (-hp- Model 741B) to A5TP1, and adjust A5R20 for a - 30.0 volt ±20 mV indication.

5-19. INPUT AMPLIFIER ZERO

a. Short 3430A INPUT terminals.

b. Center the rear panel ZERO adjust on the 3430A. This control is a ten turn potentiometer.

c. Set 3430A RANGE to 100 mV.

d. Connect dc differential voltmeter (-hp- Model 741B) to A1TP1 (input amplifier output) and circuit ground (⏚).

e. Adjust A1R84 (coarse adjust) to give 0.0 V ±10 mV.

f. Adjust the ZERO adjust (ten turn potentiometer) on the rear panel of the 3430A to give zero volts ±0.5 mV at A1TP1.

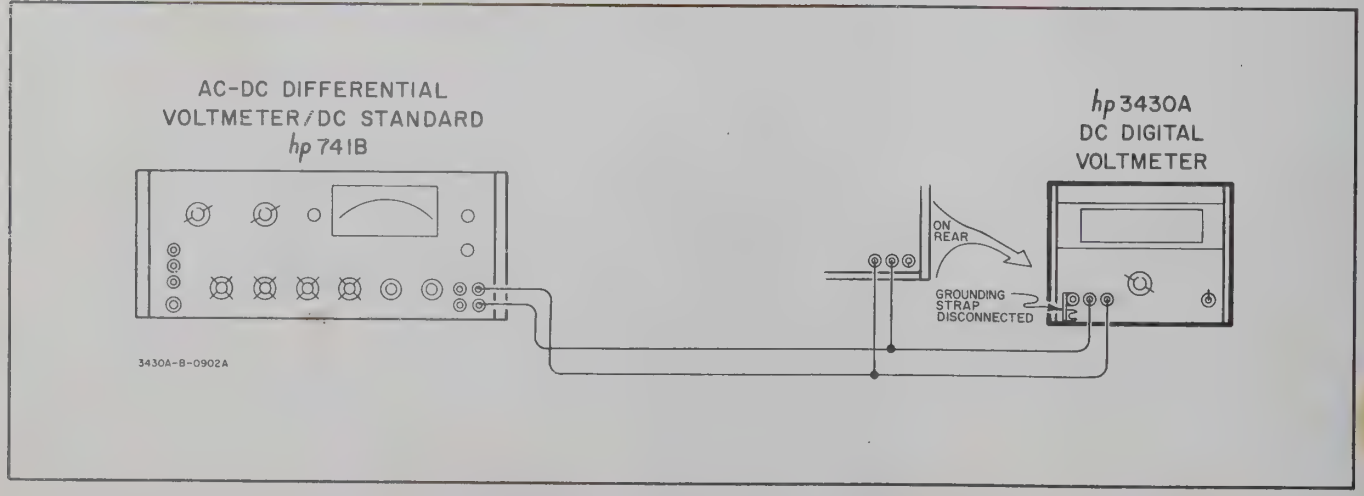


Figure 5-6. Ratio Accuracy Check

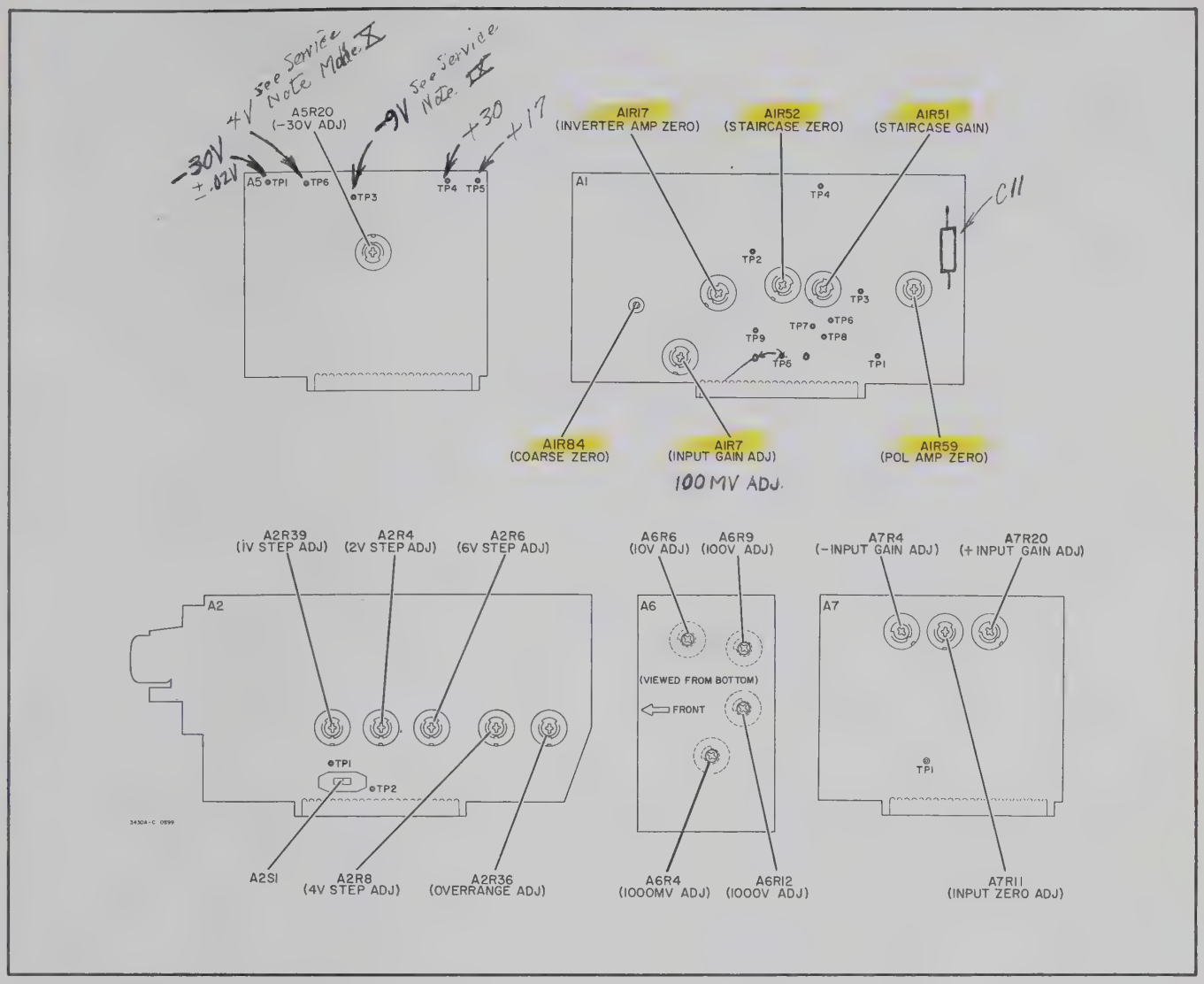


Figure 5-7. Location of Internal Adjustments

5-20. INPUT AMPLIFIER CALIBRATION.

a. Connect the Model 3430A, a dc standard and a dc differential voltmeter as shown in Figure 5-8. If a dc standard is not available, a suitable dc voltage source can be built using a mercury battery and wirewound potentiometers. The differential voltmeter can be used as a monitor to set the battery supply to the desired output.

b. Set the 3430A RANGE to 100 mV and set the dc differential voltmeter to 10 V range.

c. Set the dc standard output to -99.0 mV.

d. Place a short across A1C11 in the Sample Oscillator. This stops the 3430A from sampling, eliminating any possible transient pickup.

e. Adjust A1R7 for differential voltmeter reading of -9.90 volts. This adjusts the input amplifier gain. (Read on Dif. VM from A1TP1 to ⏚)

f. Remove short from A1C11.

CAUTION

APPLY A NEGATIVE VOLTAGE TO INPUT TERMINALS BEFORE GROUNDING A1TP1. THIS NEGATIVE INPUT PREVENTS POWER SUPPLY OVERLOADING WHEN A1TP1 IS GROUNDED DURING INVERTER AMPLIFIER ADJUSTMENT (Paragraph 5-21).

5-21. POLARITY AND INVERTER AMPLIFIER ADJUSTMENTS. OR See Service Note 03430-66511

a. Connect dc standard to 3430A INPUT. With the 3430A RANGE switch on 100 mV, adjust the dc standard output to -99.0 mV.

b. Short A1TP1 to A1TP5 (⏚). This shorts the inverter amplifier and polarity amplifier inputs.

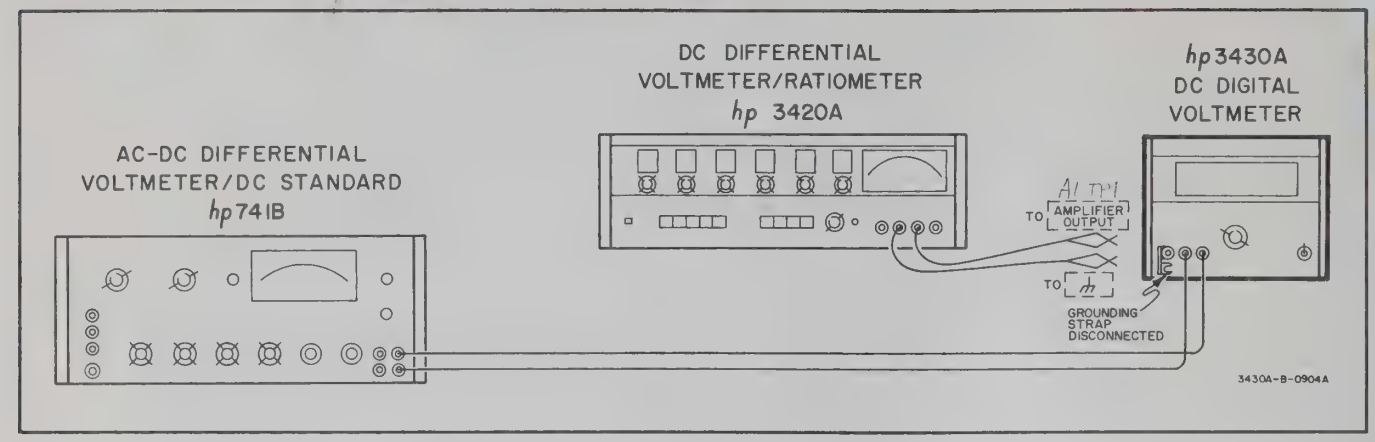


Figure 5-8. Input Amplifier Calibration

c. Slowly adjust A1R59 so that + and - indicators on front panel just change from - to +. This zeros the polarity amplifier.

d. Connect the dc differential voltmeter to the amplifier output at A1TP2.

e. Adjust A1R17 for a 0.0 V ±0.25 mV indication on the differential voltmeter.

f. Remove the short from A1TP1 to A1TP5.

NOTE

The Staircase Zero and Gain adjustment, the D/A converter adjustment, and the Staircase amplifier offset adjustment interact. Be sure to make these adjustments in the order given.

5-22. STAIRCASE AMPLIFIER ZERO AND GAIN ADJUSTMENT.

a. Connect dc standard to 3430A INPUT, and adjust its output for -99.0 mV.

b. Set 3430A RANGE to 10 V.

c. Disable the count gate by connecting a short between A1TP4 and A1TP5 (⏚).

d. Connect dc differential voltmeter to A1TP3.

e. Adjust A1R52 for a 0.0 V ±0.25 mV indication on differential voltmeter. This zeros the Staircase Amplifier.

f. Connect a 400 kΩ ±0.02% wirewound resistor between A1TP9 and A5TP3. This applies a known calibration voltage to the Staircase Amplifier. If a 400 kΩ ±0.02% resistor is not available use four 100 kΩ ±0.02% resistors (-hp- Part No. 0811-0191).

g. Adjust A1R51 for a +1.000 volt reading on the differential voltmeter (-hp- Model 741B) at A1TP3. This adjusts the Staircase Amplifier gain.

h. Remove dc differential voltmeter from A1TP3 and remove short from A1TP4 to A1TP5.

i. Remove the 400 kΩ precision resistor from A5TP3 and A1TP9.

5-23. D/A CONVERTER ADJUSTMENT.

a. Do not adjust the hundreds D/A without first adjusting staircase amplifier (Paragraph 5-22).

b. Connect dc standard to 3430A INPUT.

c. Turn off 3430A and place A2 assembly into a 22 pin extender (-hp- Part No. 5060-0630), allowing adjustment to be made while the assembly is in the 3430A circuit.

d. Place dc differential voltmeter at A1TP3.

e. Set A2S1 slide switch to TEST position, removing the internal reset pulse going to the tens and units decade counters (A3 and A4 assemblies).

f. Turn on 3430A and set RANGE to 100 mV. Adjust dc standard so the 3430A displays +10.0 mV to +10.9 mV.

g. Connect short across A1C11 and then short A2TP2 to A5TP1. The order is important. This stops the 3430A from sampling and resets the tens and units decade counters to zero. The 3430A display should not change after the two shorts are connected. If the display changes, disconnect both shorts and reconnect until the display reads the same after shorting as before shorting.

h. Adjust A2R39 for +1.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

i. Set dc voltage supply so the 3430A displays +20.0 mV to +20.9 mV.

j. Repeat step g of this paragraph.

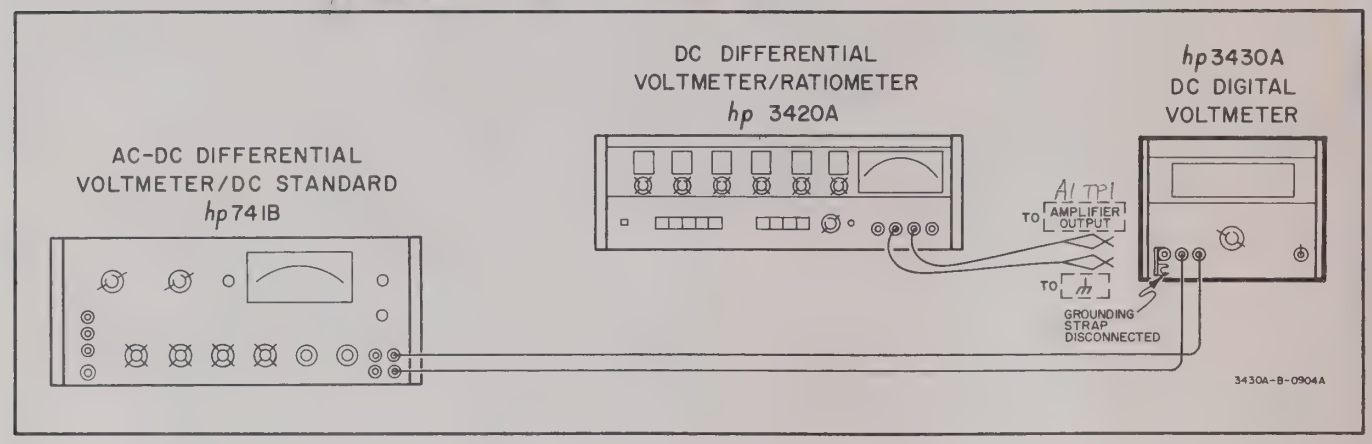


Figure 5-8. Input Amplifier Calibration

c. Slowly adjust A1R59 so that + and - indicators on front panel just change from - to +. This zeros the polarity amplifier.

d. Connect the dc differential voltmeter to the amplifier output at A1TP2.

e. Adjust A1R17 for a 0.0 V ± 0.25 mV indication on the differential voltmeter.

f. Remove the short from A1TP1 to A1TP5.

NOTE

The Staircase Zero and Gain adjustment, the D/A converter adjustment, and the Staircase amplifier offset adjustment interact. Be sure to make these adjustments in the order given.

5-22. STAIRCASE AMPLIFIER ZERO AND GAIN ADJUSTMENT.

a. Connect dc standard to 3430A INPUT, and adjust its output for -99.0 mV.

b. Set 3430A RANGE to 10 V.

c. Disable the count gate by connecting a short between A1TP4 and A1TP5 (⏚).

d. Connect dc differential voltmeter to A1TP3.

e. Adjust A1R52 for a 0.0 V ± 0.25 mV indication on differential voltmeter. This zeros the Staircase Amplifier.

f. Connect a 400 kΩ ± 0.02% wirewound resistor between A1TP9 and A5TP3. This applies a known calibration voltage to the Staircase Amplifier. If a 400 kΩ ± 0.02% resistor is not available use four 100 kΩ ± 0.02% resistors (-hp- Part No. 0811-0191).

g. Adjust A1R51 for a +1.000 volt reading on the differential voltmeter (-hp- Model 741B) at A1TP3. This adjusts the Staircase Amplifier gain.

h. Remove dc differential voltmeter from A1TP3 and remove short from A1TP4 to A1TP5.

i. Remove the 400 kΩ precision resistor from A5TP3 and A1TP9.

5-23. D/A CONVERTER ADJUSTMENT.

a. Do not adjust the hundreds D/A without first adjusting staircase amplifier (Paragraph 5-22).

b. Connect dc standard to 3430A INPUT.

c. Turn off 3430A and place A2 assembly into a 22 pin extender (-hp- Part No. 5060-0630), allowing adjustment to be made while the assembly is in the 3430A circuit.

d. Place dc differential voltmeter at A1TP3.

e. Set A2S1 slide switch to TEST position, removing the internal reset pulse going to the tens and units decade counters (A3 and A4 assemblies).

f. Turn on 3430A and set RANGE to 100 mV. Adjust dc standard so the 3430A displays + 10.0 mV to + 10.9 mV.

g. Connect short across A1C11 and then short A2TP2 to A5TP1. The order is important. This stops the 3430A from sampling and resets the tens and units decade counters to zero. The 3430A display should not change after the two shorts are connected. If the display changes, disconnect both shorts and reconnect until the display reads the same after shorting as before shorting.

h. Adjust A2R39 for +1.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

i. Set dc voltage supply so the 3430A displays + 20.0 mV to + 20.9 mV.

j. Repeat step g of this paragraph.

k. Adjust A2R4 for + 2.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

l. Set dc standard so the 3430A displays + 40.0 mV to + 40.9 mV.

m. Repeat step g of this paragraph.

n. Adjust A2R8 for +4.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

o. Set dc standard so the 3430A displays + 60.0 mV to + 60.9 mV.

p. Repeat step g of this paragraph.

q. Adjust A2R6 for +6.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

r. Set dc standard so the 3430A displays + 100.0 mV to +100.9 mV.

s. Repeat step g of this paragraph.

t. Adjust A2R36 for + 10.000 volts at A1TP3.

u. Turn 3430A line switch to OFF.

v. Remove shorts from A2TP2 to A5TP1 and across A1C11 and remove dc differential voltmeter from A1TP3. Set A2S1 to OPERATE.

w. Remove A2 assembly from the extender and install A2 assembly in the instrument.

5-24. STAIRCASE AMPLIFIER OFFSET.

5-25. The staircase offset adjusts the comparator switching point by biasing the staircase ramp.

a. Turn on 3430A.

b. Set the 3430A RANGE to 100 volts.

c. Connect dc standard to 3430A INPUT.

d. Connect the dc differential voltmeter to A1TP1.

e. Adjust the dc standard output until the dc differential voltmeter reads -15.0 mV ± 0.5 mV. Slowly adjust A1R52 until the 3430A display just changes from - 00.1 V to 00.2 V.

f. Adjust the dc standard output until the differential voltmeter reading is + 15.0 mV. Slowly adjust A1R17 until the display just changes from + 00.1 V to + 00.2 V.

5-26. INPUT ATTENUATOR CALIBRATION.

5-27. The Input Attenuator Calibration requires a dc standard (-hp- Model 741B). The calibration should be performed only if all the preceding adjustment and calibration procedures have been performed.

a. Allow the 3430A to warm up at least 10 minutes.

b. Set 3430A RANGE to 1000 mV, short 3430A INPUT terminals, and adjust ZERO on the back panel.

c. Connect dc standard to 3430A INPUT.

d. Set dc standard to + 999.0 mV.

e. Adjust potentiometer A6R4 for 3430A display of +999.0 mV.

f. Repeat steps d and e for the values shown in Table 5-3.

Table 5-3. Attenuator Adjustment

DC Standard Setting	RANGE Switch Setting	Make Adjustment On	3430A Display
+ 99.90 mV	100 mV	A1R7	+ 99.9 mV
+ 999.0 mV	1000 mV	A6R4	+ 999. mV
+ 9.990 V	10 V	A6R6	+ 9.99 V
+ 99.90 V	100 V	A6R9	+ 99.9 V
+ 999.0 V	1000 V	A6R12	+ 999. V

5-28. RATIO CALIBRATION (Option 01 Only).

a. Turn 3430A off and place A7 Ratio Reference Amplifier on 22 pin extender board. Turn 3430A back on and allow 10 minute warm up.

b. Set RATIO/NORMAL switch to NORMAL and RANGE switch to 1000 mV.

c. Connect dc differential voltmeter to A5TP3 (-9 V ref) and record the voltage to 4 significant digits.

d. Disconnect differential voltmeter from A5TP3 and connect it to A7TP1.

e. Set RATIO/NORMAL switch to RATIO and + REF - switch to + .

f. Short rear panel REF INPUT to (⏚).

g. Zero the Ratio Reference Amplifier by adjusting A7R11 for a 0.0 V ±0.25 mV reading on the dc differential voltmeter.

h. Remove short and connect dc standard in parallel to INPUT and REF INPUT terminals. Set standard output to + 1.000 V.

i. Adjust A7R20 for a differential voltmeter reading at A7TP1 equal to the reading recorded in step c.

j. Set + REF - switch to - and reverse polarity of dc standard input. Remove shorting bar between ⏚ and ⏚ terminals.

k. Adjust A7R4 for a differential voltmeter reading equal to the reading recorded in step c.

l. Turn instrument off and place A7 assembly in its connector.

5-29. TROUBLESHOOTING.

5-30. When the Model 3430A operates improperly, first adjust and calibrate it according to the procedures in Paragraph 5-15. If calibration is impossible, then proceed with the troubleshooting steps. Make sure that the trouble is not a result of conditions external to the 3430A and check for possible burned or loose components, loose connections, or any other condition which might suggest a source of trouble. Check all printed circuit boards for separations or cracks and make certain that all pins are clean and tight.

5-31. Using the block diagram and troubleshooting tree (Figure 5-9), and the troubleshooting procedure (Paragraph 5-32), isolate the trouble to a particular circuit or assembly. Then refer to the detailed troubleshooting procedure for that circuit.

5-32. TROUBLESHOOTING PROCEDURE.

5-33. The following procedure provides a quick method of isolating a malfunction to a particular circuit or assembly. Once the trouble is isolated to a given circuit, refer to the detailed troubleshooting paragraph given for that circuit. This procedure requires a dc differential voltmeter, an oscilloscope, and a dc standard.

NOTE

Whenever making measurements at A1TP2, or at A1K1 when input voltage is positive, connect a 1MΩ isolation resistor between A1TP2 or A1K1 and the input to the test instrument.

5-34. PRELIMINARY CHECKS.

a. Check power supply voltages. Table 5-4 lists correct voltages at A5 test points. All voltages are referenced to circuit ground (⏚).

Table 5-4. Power Supply Voltages

Test Point	Nominal Voltage (115 V Line)	Typical Variation with ±10% Line Voltage Change	Typical Ripple
A5TP1	-30.00±0.02 V	±0.05 V	10 mV p-p
A5TP3	- 9.00±0.50 V	±0.002 V	5 mV p-p
A5TP4	+30.00±0.90 V	±0.02 V	5 mV p-p
A5TP5	+17.00±0.50 V	±0.01 V	5 mV p-p
A5TP6	+ 4.00±0.12 V	±0.008 V	2 mV p-p

NOTE

The value of the - 9 V reference voltage measured at A5TP3 affects the value of factory selected resistors A1R3*, A1R50*, A7R12*, and A7R19*. If the - 9 V reference zener diode A5CR7 is changed, refer to Paragraph 5-76.

b. If power supply voltages are correct, apply a known half-scale voltage to all ranges. If an improper indication appears on only one range, trouble is in attenuator. If it appears on all ranges, trouble is elsewhere.

5-35. ANALOG CIRCUITS (Positive Input).

a. Set RANGE to 1000 mV, RATIO/NORMAL (Option 01 only) to NORMAL. Connect dc voltmeter between transfer (moveable) contact on top left of A1K1 (see Figure 7-3) and connect + 1.000 V from dc standard to INPUT. Reading at A1K1 should be - 10.00 V ±0.02 V. If reading is OK, input amplifier, inverter amplifier and attenuator are OK, proceed to Paragraph 5-36.

b. If voltage at A1K1 is incorrect, check voltage at A1TP1. Voltages at A1TP1 and A1K1 should be equal in magnitude, but voltage at A1TP1 should be positive. If not, trouble is in Inverter Amplifier. (See Paragraph 5-46.)

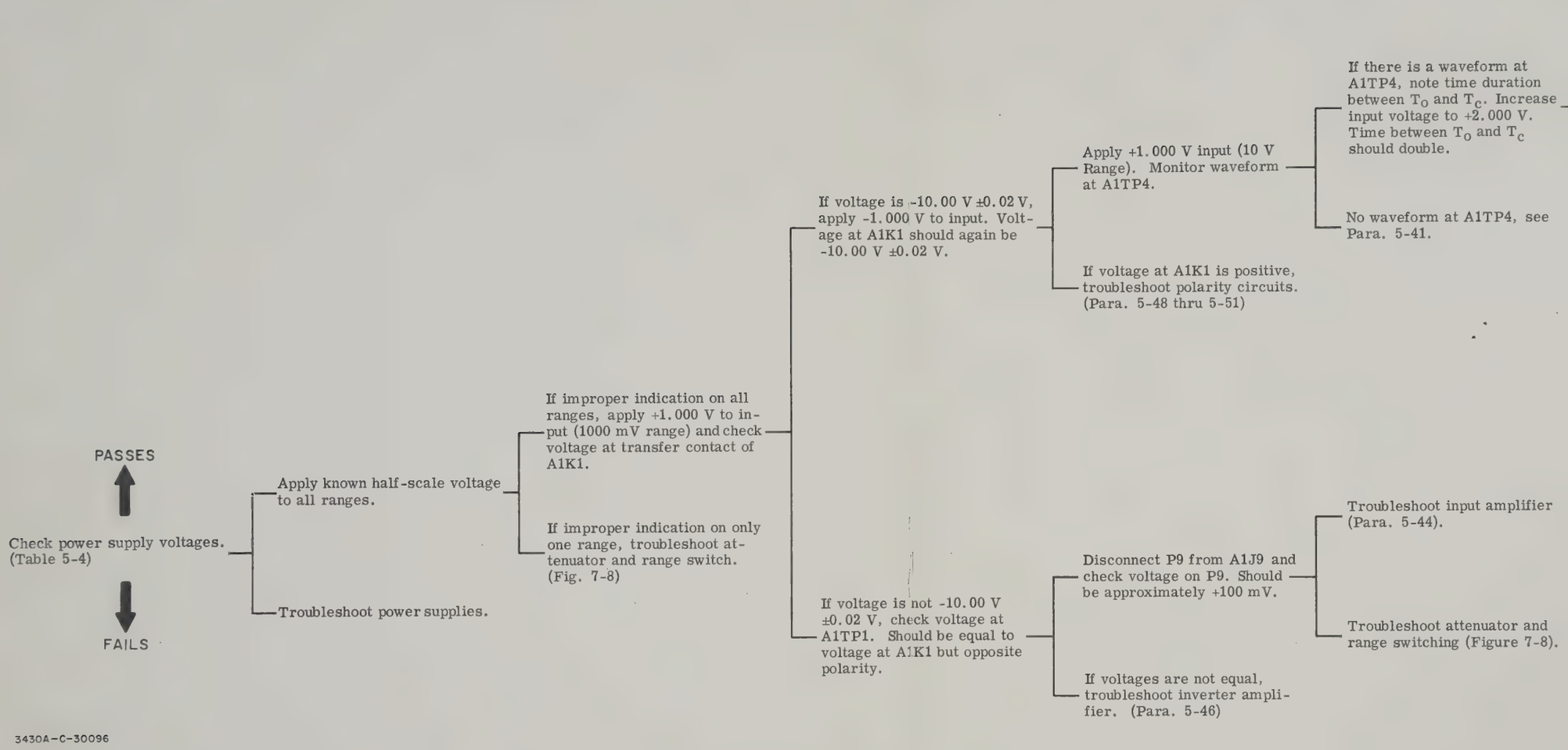
c. If voltages at A1TP1 and A1K1 are equal but not 10.00 V, disconnect P9 connector from A1J9 connector and connect dc voltmeter to P9. Voltage should be approximately + 100 mV. (Voltmeter will cause slight loading error.) If voltage is not + 100 mV, trouble is in attenuator or switching; if reading is OK, trouble is in input amplifier. (See Paragraph 5-44.)

5-36. ANALOG CIRCUITS (Negative Input).

5-37. Set dc standard output to -1.000 Vdc and connect dc voltmeter to A1K1 transfer contact. Voltage at A1K1 should be -10.00 V ±0.02 V. If voltage at A1K1 is positive, trouble is in polarity circuits. (See Paragraph 5-48 and 5-50.)

5-38. DIGITAL CIRCUITS.

5-39. With 3430A on 10 V range, connect +1 V input and monitor waveform at the comparator flip-flop (A1TP4) with an oscilloscope. The proper waveform is shown in Figure 5-10A. Note the time duration between T_O and T_C. Increase input voltage to + 2 V. Time between T_O and T_C should increase by a factor of 2. If waveform at A1TP4 is OK, all circuits except the counter, D/A, and display circuits are working, but may not be calibrated.



TROUBLESHOOTING TREE

Figure 5-9. Troubleshooting Tree

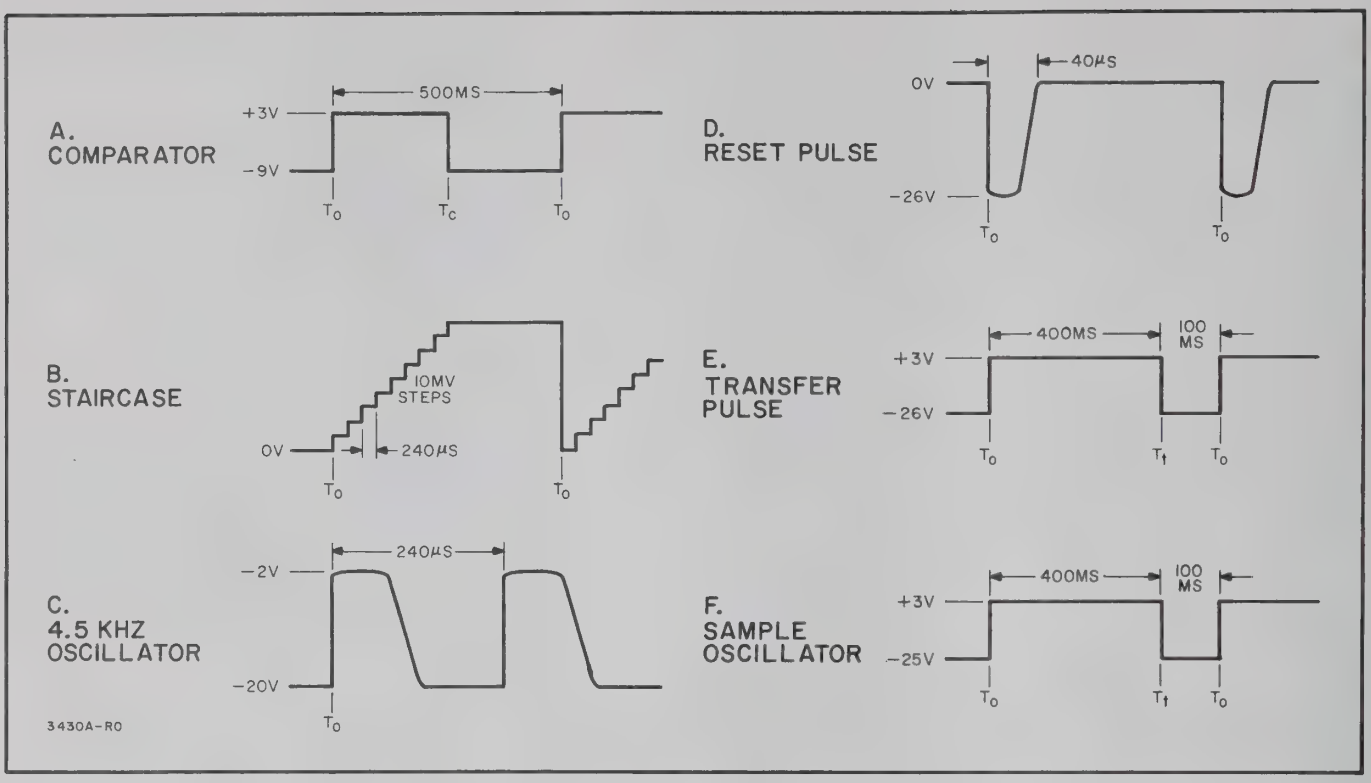


Figure 5-10. Waveforms

5-40. Incorrect Waveform at A1TP4. If there is a waveform at A1TP4, the comparator, sample oscillator, reset amplifier, and transfer amplifier are OK. Also, the staircase amplifier must be operating. However, if the time between T_O and T_C does not vary in proportion to the input, the staircase voltage is incorrect.

a. Monitor the staircase amplifier output (A1TP3) with an oscilloscope, and compare the staircase with the waveform shown in Figure 5-10B. Each step should be 10 mV amplitude and approximately 240 µsec in duration. If staircase amplitude is incorrect, check staircase amplifier gain (Paragraph 5-22) and D/A adjustments (Paragraph 5-23). If staircase gain cannot be adjusted, refer to the staircase amplifier troubleshooting procedure (Paragraph 5-64).

b. If staircase is discontinuous or intermittent, trouble is in 4.5 kHz oscillator, decade counters, or D/A converters. Apply an overload input and connect an oscilloscope to A1TP8. Compare 4.5 kHz oscillator waveform with waveform in Figure 5-10C. If waveform is incorrect, trouble is in 4.5 kHz oscillator (Paragraph 5-62). If waveform is OK, trouble is in D/A converter or counters (Paragraphs 5-66 and 5-67).

5-41. No Waveform at A1TP4. If there is no waveform at A1TP4, the digital circuits are not operating. Either the comparator is not working, the timing circuits are not working, or there is no staircase. Since the timing circuits operate independently, they should be checked first. Connect oscilloscope to A1TP7 and check for a reset pulse. (See Figure 5-10D.) If the reset pulse is OK, proceed to Paragraph 5-41a. If the reset pulse is incorrect, check the transfer pulse waveform at A1TP6. (See Figure 5-10E.) If the transfer pulse is OK, the trouble is in the Reset Amplifier. If the transfer pulse is incorrect, connect an oscilloscope to the Sample Oscillator output (collector A1Q26), and check for waveform shown in Figure 5-10F. If the Sample Oscillator waveform is OK, trouble is in Transfer Amplifier (Paragraph 5-58); if not, trouble is in Sample Oscillator (Paragraph 5-60).

a. If the timing circuits are OK, trouble may be in Staircase circuits or comparator circuits. Connect oscilloscope to A1TP3, and monitor staircase waveform. If there is a staircase waveform at A1TP3, the staircase circuits are functioning, and the trouble is probably in the comparator circuits. (See Paragraphs 5-52 and 5-54.) If there is no staircase, proceed to b.

b. Check the staircase amplifier by connecting a 400 kΩ resistor between A5TP3 and A1TP9 and monitoring the dc voltage at A1TP3. The reading at A1TP3 should be + 1.0 V. If reading is OK, proceed to c. If reading is incorrect, trouble is in staircase amplifier. (See Paragraph 5-64.)

c. Check 4.5 kHz oscillator waveform at A1TP8. Figure 5-10C shows proper waveform. If waveform is incorrect, trouble is probably in oscillator. (See Paragraph 5-62.) If waveform is OK, trouble is probably in counters or D/A. (See Paragraphs 5-66 and 5-67.)

5-42. DISPLAY.

5-43. If checks made in Paragraphs 5-34 through 5-41 show no trouble, yet display is incorrect, check display circuits or recheck calibration of instrument.

NOTE

The test voltages shown in this section are nominal. A tolerance of ±10% is acceptable.

5-44. INPUT AMPLIFIER.

5-45. If trouble is isolated to the input amplifier, measure voltages and compare with Table 5-5. Connect short across INPUT terminals and adjust zero before making measurements.

Table 5-5. Input Amplifier Voltages With Zero INPUT

Test Point		Voltage
A1Q1A	gate	0.0 V
	source	+ 2.0 V
	drain	+ 8.5 V
A1Q1B	gate	0.0 V
	source	+ 2.0 V
	drain	+ 8.5 V
A1Q2	base	0.0 V
	collector	+ 2.0 V
	emitter	- 0.6 V
A1Q3	base	+ 8.7 V
	collector	+ 17.0 V
	emitter	8.2 V
A1Q4	base	+ 8.7 V
	collector	+ 16.9 V
	emitter	+ 8.2 V

5-46. INVERTER AMPLIFIER.

5-47. Set 3430A on 1000 mV RANGE and connect + 1000 mV to INPUT. Correct voltages are shown in Table 5-6.

Table 5-6. Inverter Voltages

With + 1000 mV INPUT on 1000 mV RANGE

Test Point		Voltage
A1Q10A	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q10B	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q11	emitter	+ 3.4 V
	base	+ 4.0 V
	collector	+ 16.3 V
A1Q12	emitter	+ 4.0 V
	base	+ 3.4 V
	collector	- 10.0 V
A1TP2		- 10.0 V

5-48. POLARITY AMPLIFIER.

5-49. Set 3430A on 1000 mV RANGE and connect + 1000 mV and then - 1000 mV to INPUT. Correct voltages are shown in Table 5-7.

Table 5-7. Polarity Amplifier Voltages

Test Point		Voltage	
		+1000 mV INPUT	-1000 mV INPUT
A1Q21A	emitter	+ 4.1 V	- 1.8 V
	base	+ 4.8 V	- 2.4 V
	collector	+ 4.0 V	+ 4.0 V
A1Q21B	emitter	+ 4.1 V	- 1.8 V
	base	0.0 V	- 0.5 V
	collector	+ 8.5 V	- 1.1 V
A1Q22	emitter	+ 7.9 V	+ 3.3 V
	base	+ 8.5 V	- 1.1 V
	collector	+ 8.1 V	+ 17.0 V
A1Q23	emitter	+ 4.0 V	+ 4.0 V
	base	+ 7.9 V	+ 3.9 V
	collector	- 4.3 V	+ 3.9 V

5-50. POLARITY FLIP-FLOP.

5-51. Set 3430A on 1000 mV RANGE and connect + 1000 mV and then - 1000 mV to INPUT. Correct voltages are shown in Table 5-8.

Table 5-8. Polarity Flip-Flop Voltages

Test Point		Voltage	
		+1000 mV INPUT	-1000 mV INPUT
A1Q24	emitter	- 0.0 V	0.0 V
	base	- 0.8 V	+ 3.5 V
	collector	0.1 V	- 15.2 V
A1Q25	emitter	0.0 V	0.0 V
	base	.1 V	- .78 V
	collector	- 16.6 V	- .1 V

5-52. COMPARATOR.

5-53. Set 3430A on 1000 mV RANGE and connect short circuit across INPUT terminals. Adjust ZERO control on rear panel. Correct voltages are shown in Table 5-9.

Table 5-9. Comparator Voltages

With Shorted INPUT Terminals and Display of 000

Test Point		Voltage
A1Q13A	emitter	- .6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q13B	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q14	emitter	+ 3.7 V
	base	+ 4.0 V
	collector	+ 13.5 V
A1Q15	emitter	+ 4.0 V
	base	+ 3.7 V
	collector	- 8.5 V

5-54. COMPARATOR FLIP-FLOP.

5-55. Set 3430A on 1000 mV RANGE and connect short circuit across INPUT terminals. Adjust ZERO control on rear panel. Voltages should be approximately as in Table 5-10.

Table 5-10. Comparator Flip-Flop Voltages

With Shorted INPUT Terminals

Test Point		Voltage
A1Q16	emitter	0.0 V
	base	- 0.7 V
	collector	0.0 V
A1Q17	emitter	0.0 V
	base	- 0.32 V
	collector	- 20.7 V

5-56. RESET AMPLIFIER.

5-57. Connect short circuit across A1C11. This will disable the sample oscillator. Correct voltages are shown in Table 5-11.

Table 5-11. Reset Amplifier Voltages

With A1C11 Shorted

Test Point		Voltage
A1Q29	emitter	- 29.2 V
	base	- 29.7 V
	collector (A1TP7)	+ 0.5 V

5-58. TRANSFER AMPLIFIER.

5-59. Connect short across A1C11. This will disable sample oscillator. Correct voltages are shown in Table 5-12.

Table 5-12. Transfer Amplifier Voltages

A1C11 Shorted

Test Point		Voltage
A1Q28	emitter	+ 3.7 V
	base	+ 4.4 V
	collector (A1TP6)	+ 4.0 V

5-60. 2 HZ SAMPLE OSCILLATOR.

5-61. Connect short circuit across A1C11 to disable circuit. Correct voltages are shown in Table 5-13.

Table 5-13. Sample Oscillator Voltages

With A1C11 Shorted

Test Point		Voltage
A1Q26	emitter	*
	base	- 29.7 V
	collector	+ 4.4 V
A1Q27	emitter	- 7.7 V
	base	- 7.0 V
	collector	- 30.0 V

* Do not measure

5-62. 4.5 KHZ OSCILLATOR.

5-63. Connect short circuit across A1C8 to stop oscillator. Correct voltages are shown in Table 5-14.

Table 5-14. 4.5 kHz Oscillator Voltages

With A1C11 and A1C8 Shorted

Test Point		Voltage
A1Q8	emitter	*
	base	0.0 V
	collector	- 18.9 V
A1Q9	emitter	*
	base	- 9.9 V
	collector	0.0 V

* Do not measure

5-64. STAIRCASE AMPLIFIER.

5-65. Connect short circuit across INPUT of 3430A and adjust rear panel ZERO. Correct voltages are shown in Table 5-15.

Table 5-15. Staircase Amplifier Voltages

Test Point		Voltage
A1Q18A	emitter	- .6 V
	base	0.0 V
	collector	+ 17.0 V
A1Q18B	emitter	- .6 V
	base	0.0 V
	collector	+ 17.0 V
A1Q19	emitter	+ 16.4 V
	base	+ 17.0 V
	collector	+ 29.2 V
A1Q20	emitter	+ 17.0 V
	base	+ 16.4 V
	collector	0.0 V

5-66. COUNTER CIRCUITS.

a. Set 3430A RANGE to 1000 mV and apply + 2.0 V to input. Then connect short across A1C11. This will allow counter to free-run. Connect oscilloscope to units counter output (A4 pin 14). The output waveform should be similar to the 4.5 kHz oscillator waveform (Figure 7-2), but 1/10th the frequency. If waveform is OK, proceed to b. If waveform is incorrect, connect oscilloscope to collector of A4Q2, A4Q4, A4Q6, and A4Q8 respectively. In each case the waveform should be a switching waveform. If not, the trouble is in the binary associated with transistor under test.

b. Connect oscilloscope to tens counter output (A3 pin 14). Output waveform should be similar to units counter output waveform, but 1/10th the frequency. If waveform is OK, proceed to c. If waveform is incorrect, connect oscilloscope to collector of A3Q2, A3Q4, A3Q6, and A3Q8 respectively. In each case the waveform should be a switching waveform. If not, the trouble is in the binary associated with transistor under test.

c. Connect oscilloscope to hundreds counter output (collector of A2Q7). The output waveform should be similar to the tens counter output, but 1/10th the frequency. If waveform is OK, trouble is in overrange binary (A2Q20 and A2Q21) or overrange flip-flop (A2Q26 and A2Q27). If waveform is incorrect, check waveform at collector of A2Q2, A2Q4, and A2Q6 respectively. In each case the waveform should be a switching waveform. If not the trouble is in the binary associated with the transistor under test.

5-67. D/A CONVERTERS.

5-68. The D/A converters can best be checked by analyzing the front panel indication.

a. Set 3430A RANGE to 100 V. Connect dc standard to INPUT. Set dc standard to 100 V. If overrange digit should light, proceed to b. Otherwise trouble is in overrange D/A.

b. Set 3430A RANGE to 1000 V and apply + 10 V. Hundreds digit (most significant) should be zero. Increase input to 110 V. Hundreds digit should change to 1. Increase input voltage in 100 V increments to 910 V. Each time input voltage is increased, hundreds digit should increase by 1. If hundreds digit indication is OK, proceed to step c. If not, trouble is in hundreds D/A.

c. Set dc standard to 5 V. Tens (center) digit should be zero. Increase input voltage to 15 V. Tens digit should change to 1. Increase input voltage in 10 volt increments to 95 volts. Each time voltage is changed, tens digit should increase by 1. If tens digit is OK, proceed to step d. If not, trouble is in tens D/A.

d. Set dc standard to 0 volts. Units (least significant) digit should be zero. Set standard to 1.0. Units digit should change to 1. Increase standard output in 1 V increments to 9 V. Each time voltage is increased, units digit should increase by 1. If indication is OK, trouble is not in D/A converters. If not, trouble is in units D/A.

5-69. OPTION: RATIO REFERENCE AMPLIFIER.

5-70. Set 3430A on 10 V RANGE. Connect +1 V dc to rear panel REF input. Set REF ± slide switch to + and set RATIO/NORMAL slide switch to RATIO. Connect + 10 volts to front panel INPUT. Correct voltages are shown in Table 5-16.

Table 5-16. Option 01 Ratio Reference Amp Voltages

Test Point		Voltage
A7Q1A	source	+ 2.0 V
	drain	+ 8.3 V
	gate	0.0 V
A5Q1B	source	+ 2.0 V
	drain	+ 8.3 V
	gate	0.0 V
A7Q2	emitter	- 1.3 V
	base	- 0.7 V
	collector	+ 2.0 V
A7Q3	emitter	+ 7.8 V
	base	+ 8.3 V
	collector	+ 11.9 V
A7Q4	emitter	+ 7.8 V
	base	+ 8.3 V
	collector	+ 14.2 V
A7Q5	emitter	+ 13.9 V
	base	+ 11.6 V
	collector	+ 14.2 V
A7Q6	emitter	+ 3.8 V
	base	+ 3.2 V
	collector	- 8.9 V

5-71. ADJUSTMENT OF FACTORY SELECTED COMPONENTS.

5-72. Eight resistors within the Model 3430A are individually selected in order to compensate for slightly varying circuit parameters. These resistors are denoted by an asterisk (*) on the schematic, and the typical value is shown. The following paragraphs describe the function of the factory selected components, and give instructions for their selection. Normally, these components need not be changed unless another associated component is changed. Replacement of the reference voltage zener diode for example, may require changing a factory selected component.

5-73. A6R3*.

a. A6R3* adjusts the total resistance of the input attenuator. A6R3* should never be changed unless A6R2 or A6R4 is replaced.

b. If the 3430A cannot be calibrated to Paragraphs 5-26 and 5-27, A6R3* should be changed. If adjustment of A6R4, A6R6, A6R9, or A6R12 result in consistently high or low voltage readings at A1TP1, A6R3* should be changed. If the absolute value of the voltage at A1TP1 is high, increase the resistance of A6R3*.

c. Factory values of A6R3* vary from 100 ohms to 110 kΩ.

d. Changing A6R3* requires recalibration of the Input Attenuator (Paragraph 5-26).

5-74. A1R14*.

a. A1R14* may be used to adjust the feedback of the inverter amplifier. The amplifier gain should be -1. For example, if the voltage at A1TP1 is +10.000 V, the voltage at A1TP2 should be -10.000 V. If A1R15 and A1R16 are equal in value, A1R14* becomes zero ohms and a shorting wire is inserted in the printed circuit board in place of A1R14*. A1R15 and A1R16 are matched for resistance value and temperature coefficient. There should be no reason to change A1R14* unless A1R15 or A1R16 is changed.

b. If A1R15 and A1R16 are not matched in value to within 1.5 ohms, the resistor with the higher value should be placed in the A1R15 position, and the one with the lower value in the A1R16 position. A1R14* should then be selected to adjust the gain of the amplifier. With 100.0 mV input to the 3430A on the 100 mV range, A1R14* should be increased 1.5 ohms per millivolt of error at A1TP2, to a maximum of 9.0 ohms.

c. Adjusting the value of A1R14* requires no further calibration.

5-75. A1R4* and A1R5*.

a. A1R4* and A1R5* are selected to adjust the bias of A1Q1A and A1Q1B in order to correct for zero drift of up to 3 counts during instrument warmup. Decreasing A1R4* or increasing A1R5* by 1 kΩ will shift the temperature coefficient of the amplifier about -10 $\mu V/^{o}C$, correcting for approximately 1 count of positive drift. Increasing A1R4* or decreasing A1R5* by 1 kΩ will shift the temperature coefficient about +10 $\mu V/^{o}C$. Since A1R4* and A1R5* have a tolerance of ±1%, a replacement resistor should be compared to the original on a high resolution ohmmeter or bridge to be sure the desired change is being made.

b. If the zero drift cannot be corrected by adjusting the value of A1R4* or A1R5*, or is greater than 3 counts, and the power supply voltages and regulation are satisfactory, (see Table 5-4), A1Q1, A1Q2, A1Q3 or A1Q4 may be defective.

c. Changing A1R4*, A1R5*, A1Q1, A1Q2, A1Q3, or A1Q4 requires recalibration of the input amplifier zero and gain (see Paragraphs 5-19 and 5-20).

5-76. A1R3*, A1R50*, A7R12* (Option 01), and A1R19* (Option 01).

a. The value of factory selected resistors A1R3*, A1R50*, A7R12*, and A7R19* is affected by the actual voltage of the - 9 V reference supply. It should not be necessary to change any of these resistors unless the - 9 V reference zener diode A5CR7 or the power supply assembly A5 is changed. Table 5-17 shows suggested values for these resistors for various - 9 V reference voltages. Since parameters other than the - 9 V reference supply may affect the values of these resistors, the values determined by the use of Table 5-17 may not be optimum.

b. Measure the - 9 V reference voltage at A5TP3 and locate the corresponding point at the sides of Table 5-17. Place a straightedge across Table 5-17 and determine the resistor value in the appropriate column.

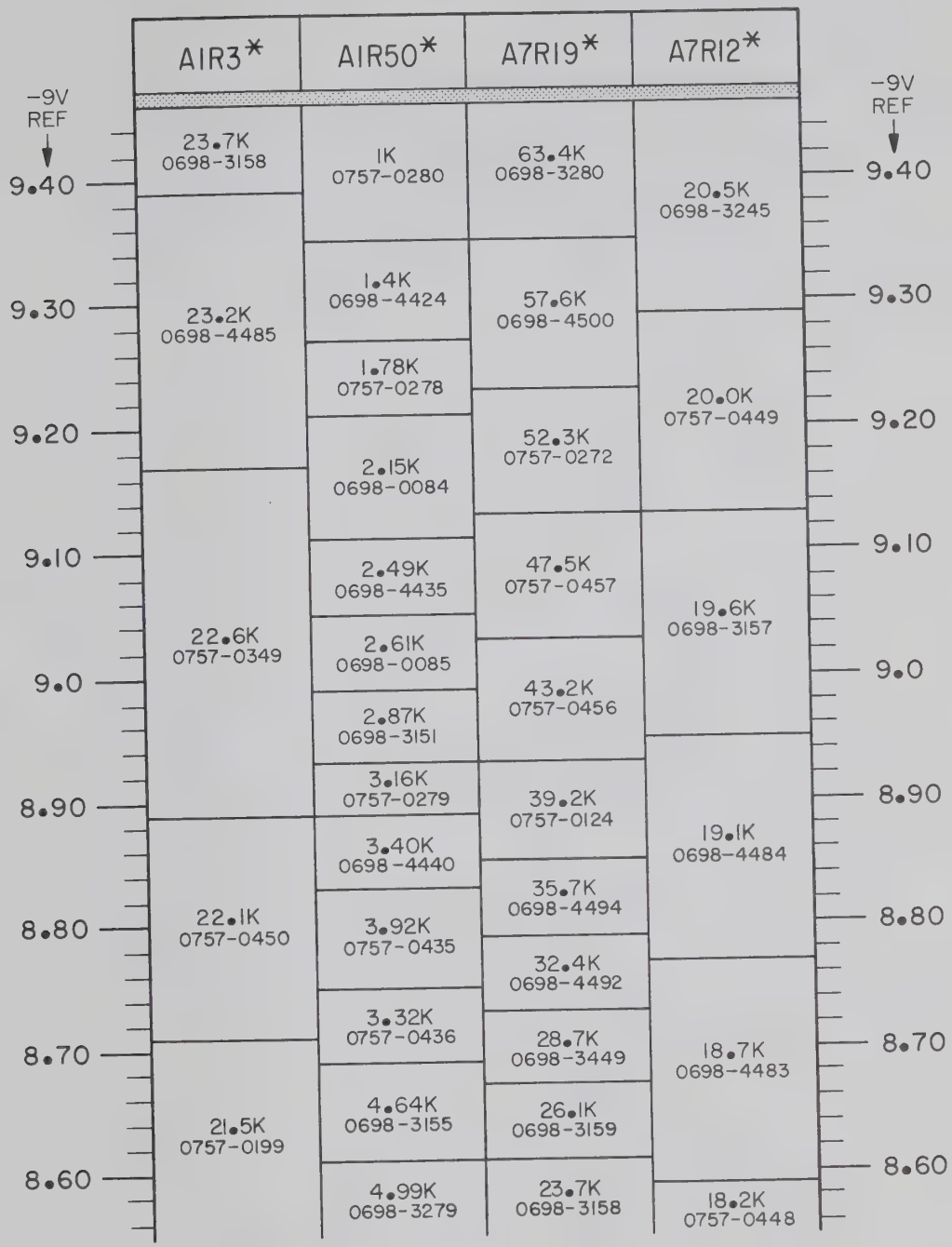
c. A1R3* controls the current in the constant current source in the input amplifier. Changing A1R3* requires no additional calibration.

d. A1R50* controls the staircase amplifier gain. If adjustment of A1R51 in Paragraph 5-22, step g, results in consistently low voltage readings, decrease the negative feedback to the amplifier by increasing A1R50*. Changing A1R50* requires recalibration of the staircase amplifier gain (see Paragraph 5-22).

e. A7R12* controls the zero range of the ratio reference amplifier. If adjustment of A7R11 in Paragraph 5-28, step h, results in a consistently negative voltage at A7TP1, increase the resistance of A7R12*. Changing A7R12* requires calibration of the ratio reference amplifier (see Paragraph 5-28).

f. A7R19* controls the feedback of the ratio reference amplifier. If adjustment of A7R20 in Paragraph 5-28, step i, results in voltage readings that are consistently too negative, increase the feedback by decreasing A7R19*. Changing A7R19* requires calibration of the ratio reference amplifier (see Paragraph 5-28).

Table 5-17. Factory Selected Resistor Values



ALL RESISTOR VALUES ±1%, 1/8W METAL FILM
-HP- PART NUMBERS SHOWN

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3430A
DC Digital Voltmeter

Serial No. ___ - _____

Tests performed by _____
Date _____

PARAGRAPH	DESCRIPTION	CHECK		
5-7	ACCURACY CHECK	± (0.1% of reading + 1 digit)		
		Range	Reading (with full scale input)	
			Positive	Negative
		100 MV	_____	_____
		1000 MV	_____	_____
		10 V	_____	_____
		100 V	_____	_____
		1000 V	_____	_____
5-8	INPUT RESISTANCE CHECK	10 MΩ ±3.0%		_____
5-9	OVERLOAD INDICATION CHECK	Flashing display		_____
5-10	NOISE REJECTION CHECK	40 dB at 60 Hz		_____
	COMMON MODE REJECTION CHECK	> 90 dB on 100 mV Range		
5-12	DC			_____
5-13	AC			_____
5-14	RATIO ACCURACY CHECK (OPTION 01 ONLY)	± (0.15% of reading + 1 digit)		_____

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	TC	= thermocouple
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	HR	= heater	Q	= transistor		
C	= capacitor	IC	= integrated circuit	QCR	= transistor-diode	W	= cable
CR	= diode	J	= jack	R	= resistor	X	= socket
DL	= delay line	K	= relay	RT	= thermistor	XDS	= lampholder
DS	= lamp	L	= inductor	S	= switch	XF	= fuseholder
E	= misc electronic part	M	= meter	T	= transformer	Z	= network

ABBREVIATIONS

Ag	= silver	ID	= inside diameter	ns	= nanosecond (s) = 10^{-9} seconds	sl	= slide
Al	= aluminum	impg	= impregnated	nsr	= not separately replaceable	SPDT	= single-pole double-throw
A	= ampere (s)	incd	= incandescent			SPST	= single-pole single-throw
Au	= gold	ins	= insulation (ed)				
C	= capacitor	kΩ	= kilohm (s) = 10^{+3} ohms	Ω	= ohm (s)	Ta	= tantalum
cer	= ceramic	kHz	= kilohertz = 10^{+3} hertz	obd	= order by description	TC	= temperature coefficient
coef	= coefficient			OD	= outside diameter	TiO_2	= titanium dioxide
com	= common	L	= inductor	p	= peak	tog	= toggle
comp	= composition	lin	= linear taper	pc	= printed circuit	tol	= tolerance
conn	= connection	log	= logarithmic taper	pF	= picofarad (s) = 10^{-12} farads	trim	= trimmer
dep	= deposited	m	= milli = 10^{-3}	piv	= peak inverse voltage	TSTR	= transistor
DPDT	= double-pole double-throw	mA	= milliampere (s) = 10^{-3} amperes	p/o	= part of	V	= volt (s)
DPST	= double-pole single-throw	MHz	= megahertz = 10^{+6} hertz	pos	= position (s)	vacw	= alternating current working voltage
elect	= electrolytic	MΩ	= megohm (s) = 10^{+6} ohms	poly	= polystyrene	var	= variable
encap	= encapsulated	met flm	= metal film	pot	= potentiometer	vdcw	= direct current working voltage
F	= farad (s)	mfr	= manufacturer	p-p	= peak-to-peak		
FET	= field effect transistor	mtg	= mounting	ppm	= parts per million	W	= watt (s)
fxd	= fixed	mV	= millivolt (s) = 10^{-3} volts	prec	= precision (temperature coefficient, long term stability, and/or tolerance)	w/	= with
GaAs	= gallium arsenide	μ	= micro = 10^{-6}			wiv	= working inverse voltage
GHz	= gigahertz = 10^{+9} hertz	μV	= microvolt (s) = 10^{-6} volts			w/o	= without
gd	= guard (ed)	my	= Mylar ®	R	= resistor	ww	= wirewound
Ge	= germanium	nA	= nanoampere (s) = 10^{-9} amperes	Rh	= rhodium	*	= optimum value selected at factory, average value shown (part may be omitted)
grd	= ground (ed)	NC	= normally closed	rms	= root-mean-square		
H	= henry (ies)	Ne	= neon	rot	= rotary	**	= no standard type number assigned (selected or special type)
Hg	= mercury	NO	= normally open	Se	= selenium		
Hz	= hertz (cycle (s) per second)	NPO	= negative positive zero (zero temperature coefficient)	sect	= section (s)		
				Si	= silicon		

REV G

® Dupont de Nemours

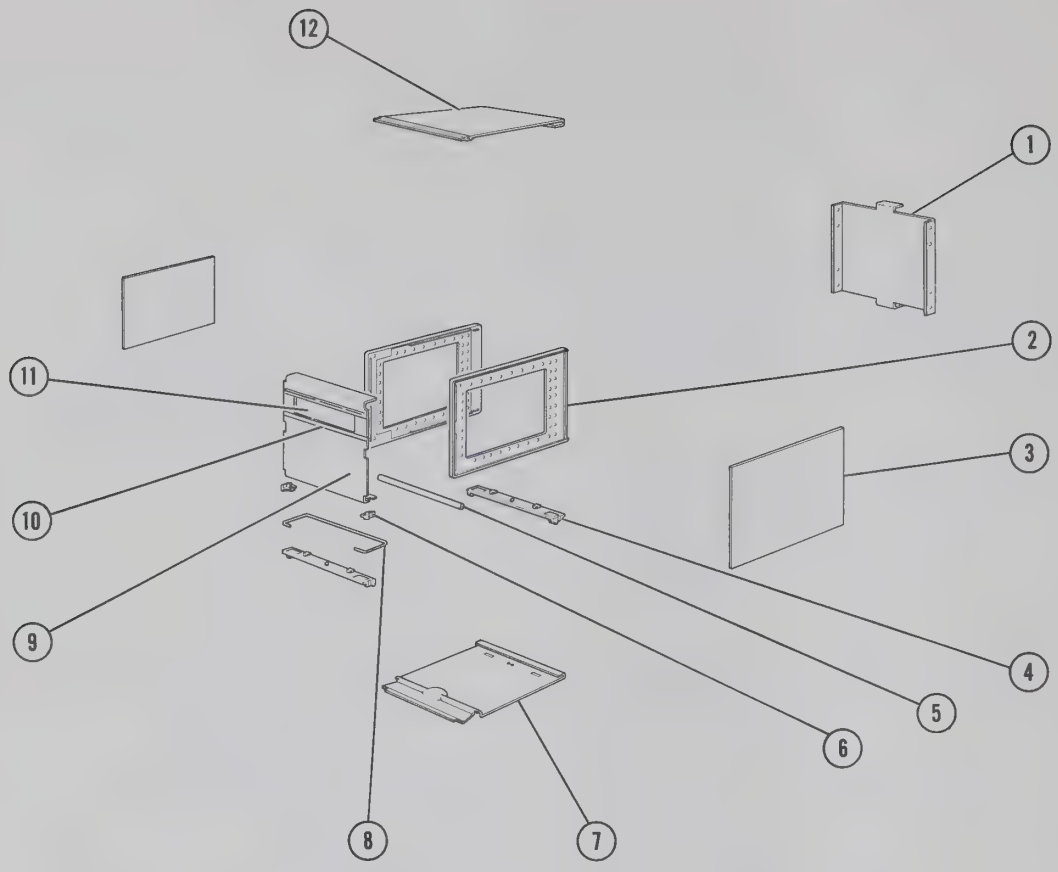
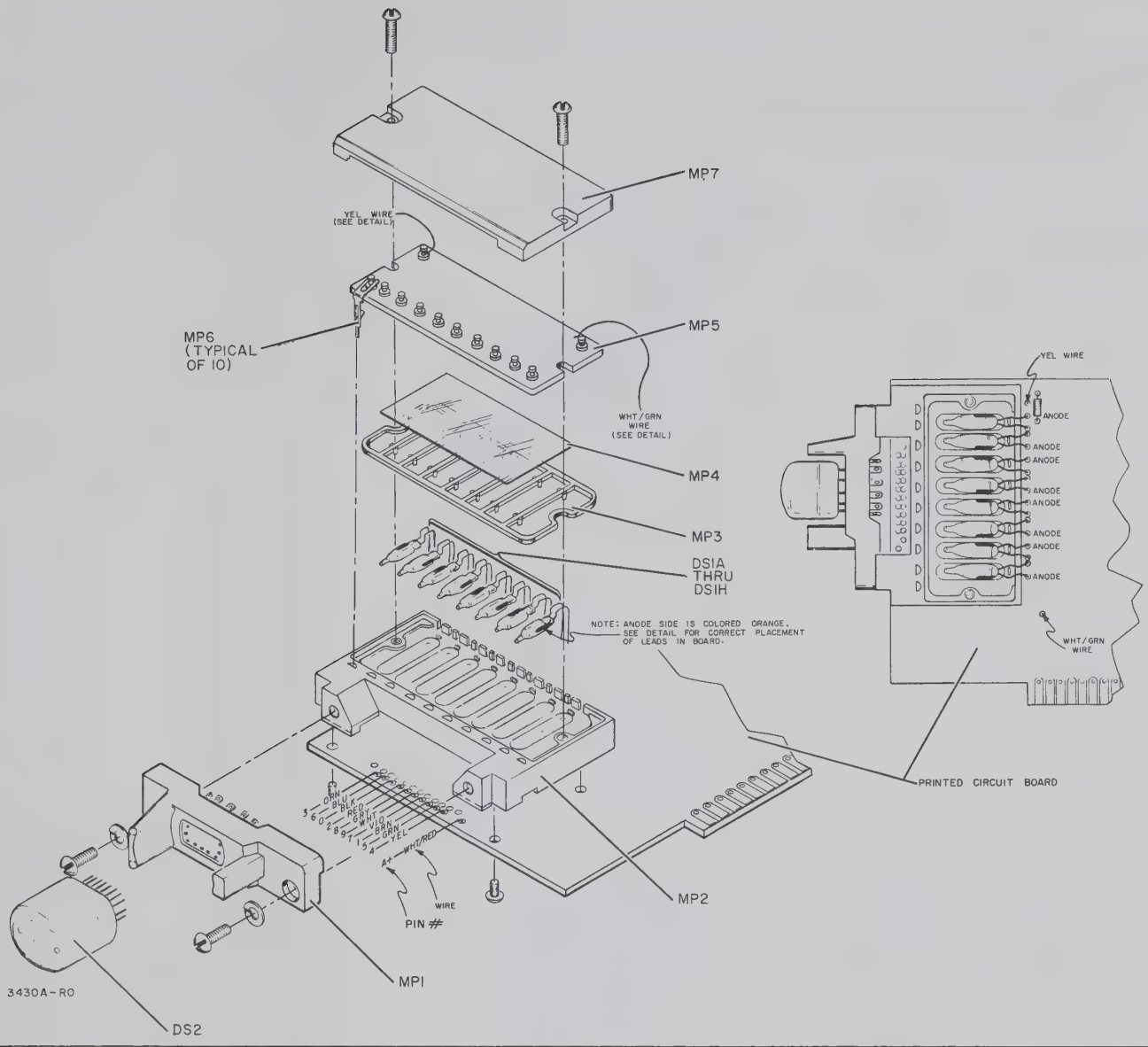


Figure 6-1. Chassis Parts

Reference	-hp- Part No.	Description	TQ	Mfr.	Mfr. Part No.
1	03430-00202	Panel rear	1	-hp-	
2	5060-0703	Frame assembly	2	-hp-	
3	5000-0703	Side Cover	2	-hp-	
	2370-0020	Screw: Phillips 3/16 in. hardware for side cover	8	83385	obd
4	5060-0728	Foot assembly	2	-hp-	
5	5020-5310	Spacer: cabinet	1	-hp-	
6	5040-0700	Hinge	2	-hp-	
7	5000-0717	Bottom cover	1	-hp-	
	2370-0016	Screw: Phillips 3/16 in. hardware for top and bottom covers	4	83385	obd
8	1490-0032	Tilt stand: half module	1	91260	obd
9	03430-00201	Front panel	1	-hp-	
10	03430-48301	Bezel: trim	1	-hp-	
11	5040-4523	Window: plexiglass	1	-hp-	
12	5060-0724	Top cover	1	-hp-	



Reference	-hp- Part No.	Description	Mfr.	Mfr. Part No.
DS1A thru DS1H	03430-88401	Lamp: neon matched set of 8	-hp-	
DS2	1970-0009	Tube: numerical indicator	83594	GA287
MP1	5060-0641	Socket: indicator tube	-hp-	
	2360-0004	Screw: hardware for MP1	80120	obd
	2190-0006	Washer: hardware for MP1	80120	obd
MP2	5040-0696	Block: photoconductor	-hp-	
	2200-0061	Screw: hardware for MP2	-hp-	
MP3	5040-4501	Gasket	-hp-	
MP4	05212-0011	Shield: transparent	-hp-	
MP5	1990-0009	Photoconductor matrix	-hp-	
MP6	1400-0283	Spring clip	-hp-	
MP7	5212A-83C	Cover	-hp-	
	2200-0006	Screw: hardware for MP7	73076	obd

Figure 6-2. Miscellaneous Parts, A2, A3, and A4 Assemblies

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	03430-66508		1	Assembly: Amplifier	-hp-	
C1, C2	0160-0163		2	C: fxd 0.033 μF ±10%	56289	192P33392
C3	0160-2137		1	C: fxd my 0.27 μF ±10% 100 vdcw	56289	148P27491
C4	0160-0938		2	C: fxd mica 1000 pF ±5%	04062	RDM15E102J1C
C5				Not assigned		
C6	0140-0176		4	C: fxd mica 100 pF ±2%	04062	RDM15F101G3C
C7	0160-0128		1	C: fxd cer 2.2 μF ±20% 25 vdcw	56289	5C15C2
C8	0160-2009		1	C: fxd mica 820 pF ±20%	04062	RDM15F821J3C
C9	0140-0190		1	C: fxd mica 39 pF ±5%	04062	RDM15E390J3C
C10	0140-0197		1	C: fxd mica 180 pF	04062	RDM15F181J3C
C11	0170-0042		1	C: fxd my 0.33 μF ±5% 100 vdcw	99515	obd
C12	0140-0209		1	C: fxd mica 5 pF ±10% 100 vdcw	04062	RDM15C050K5C
C13	0140-0179			C: fxd mica 1000 pF ±2%	04062	RDM19F102G3C
C14	0180-0049		1	C: fxd Al elect 20 μF +75% -10% 50 vdcw	56289	30D206G050CC2-DSM
C15	0160-0362		4	C: fxd mica 510 pF ±5%	04062	RDM15F11J3C
C16	0180-0393		1	C: fxd cer 39 μF ±10% 10 vdcw	56289	30D107G003CB4
C17	0160-2212		1	C: fxd mica 560 pF ±5%	04062	RDM19F561J3C
C18	0160-0174		1	C: fxd cer 0.47 μF +80% -20% 25 vdcw	56289	5C11B7
C19	0140-0208		1	C: fxd mica 680 pF ±5%	04062	RDM19F561J3C
CR1, CR2	1901-0156		4	Diode: Si 50 mA at +1 V	01281	PS5553
CR3 thru CR8	1901-0025		43	Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
J1 thru J8				Not assigned		
J9	1251-0131		1	Connector: miniature female	00373	69026-1164 (Red)
K1	0490-0391		1	Relay: reed	-hp-	
Q1A,B	1855-0036		2	TSTR: FET dual	15818	SU2119
Q2	1854-0071		19	TSTR: Si NPN 2N3391	24446	4JX16A1014
Q3, Q4	1854-0266		4	TSTR: NPN 2N3711	01295	obd
Q5	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q6 thru Q8	1853-0036		13	TSTR: Si PNP 2N4122	07263	2N4122
Q9	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q10A,B	1854-0221		4	TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q11	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q12	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122
Q13A,B	1854-0221			TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q14	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q15	1853-0016		10	TSTR: Si PNP 2N3638	07263	2N3638
Q16, Q17	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122
Q18A,B	1854-0221			TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q19	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q20	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122
Q21A,B	1854-0221			TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q22	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014
Q23	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122
Q24, Q25	1853-0023		2	TSTR: Si PNP 2N3703	01295	obd
Q26	1854-0087			TSTR: Si NPN 2N3417	04713	MPS3417
Q27	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122
Q28, Q29	1854-0087			TSTR: Si NPN 2N3417	04713	MPS3417
R1				Not assigned		
R2	0684-2241		3	R: fxd comp 220 kΩ ±10% 1/4 W	01121	CB2241
R3*	0757-0773			See Paragraph 5-76		
R4, R5	0757-0776		2	R: fxd 110 kΩ ±1% 1/4 W	19701	MF6C T-O obd
R6	0811-1789		7	R: fxd prec ww 985 Ω ±0.1% 1/40 W	05347	102A obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)							
R7	2100-1560		2	R: var ww 30 Ω ±10% 1-1/2 W	11236	110	obd
R8	0757-0064		1	R: fxd met flm 261 kΩ ±1% 1/2 W	75042	CEC T-O	obd
R9	0811-1794		2	R: fxd prec ww 99.25 kΩ ±0.1% 1/40 W	05347	102A	obd
R10	0757-0145		1	R: fxd met flm 750 kΩ ±1% 1/4 W	75042	obd	
R11	0683-2225		1	R: fxd 2200 Ω ±5% 1/4 W	01121	CB2225	
R12	0684-3331		3	R: fxd comp 33 kΩ ±10% 1/4 W	01121	CB3331	
R13	0686-3925		1	R: fxd 3900 Ω ±5% 1/2 W	01121	EB3925	
R14*				See Paragraph 5-80			
R15, R16	03430-82601		2	R: fxd 15 kΩ ±1% matched set of two part of matched sets of two	-hp-		
R17	2100-0282		4	R: var ww 2000 Ω ±20% 1-1/2 W	71450	110	obd
R18	0698-3464		2	R: fxd met flm 1.47 MΩ ±1% 1/2 W	75042	CEC T-O	obd
R19	0684-4721		3	R: fxd 4700 Ω ±10% 1/4 W	01121	CB4721	
R20	0684-1231		3	R: fxd comp 12 kΩ ±10% 1/4 W	01121	CB1231	
R21	0683-2725		2	R: fxd 2.7 kΩ ±5% 1/4 W	01121	CB2725	
R22	0686-4725		2	R: fxd 4700 Ω ±5% 1/2 W	01121	EB4725	
R23	0684-1531		7	R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531	
R24	0684-2731		3	R: fxd comp 27 kΩ ±10% 1/4 W	01121	CB2731	
R25	0757-0199		1	R: fxd met flm 21.5 kΩ ±1% 1/8 W	000LM	obd	
R26	0698-3456		1	R: fxd met flm 287 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R27, R28	0698-3160		3	R: fxd met flm 31.6 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R29	0757-0123		1	R: fxd 34.8 kΩ ±1% 1/8 W	75042	CEA T-O	obd
R30, R31	03430-82601			R: fxd 15 kΩ ±1% matched set of two part of matched sets of two	-hp-		
R32	0698-4074		1	R: fxd met flm 1.02 MΩ ±1% 1/2 W	75042	CEC T-O	obd
R33				Not assigned			
R34	0757-0350		1	R: fxd met flm 909 kΩ ±1% 1/4 W	75042	obd	
R35	0684-1531			R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531	
R36	0684-1031		3	R: fxd 10 kΩ ±10% 1/4 W	01121	CB1031	
R37	0684-1531			R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531	
R38	0684-8231		1	R: fxd comp 82 kΩ ±10% 1/4 W	01121	CB8231	
R39	0684-2731			R: fxd 27 kΩ ±10% 1/4 W	01121	CB2731	
R40	0684-1061		1	R: fxd comp 10 MΩ ±10% 1/4 W	01121	CB1061	
R41	0684-1241		1	R: fxd 120 kΩ ±10% 1/4 W	01121	CB1241	
R42	0684-1831		1	R: fxd 18 kΩ ±10% 1/4 W	01121	CB1831	
R43, R44	0684-5631		5	R: fxd 56 kΩ ±10% 1/4 W	01121	CB5631	
R45	0684-1541		2	R: fxd 150 kΩ ±10% 1/4 W	01121	CB1541	
R46	0684-6831		5	R: fxd comp 68 kΩ ±10% 1/4 W	01121	CB6831	
R47				Not assigned			
R48	0757-0871		2	R: fxd met flm 1.21 MΩ ±1% 1/2 W	91637	MFF 1/2 T-O	
R49	0698-5166		1	R: fxd ww 41.2 kΩ ±1% 1/8 W	75042	CEA T-9	
R50*				See Paragraph 5-77			
R51	2100-2069		1	R: var comp 1000 Ω ±20% 1/2 W	71450	RV5LAYSB255B	
R52	2100-0282			R: var ww 2000 Ω ±20% 1-1/2 W	71450	110	obd
R53	0757-0017		1	R: fxd 1 MΩ ±.5% 1/2 W	75042	CEC T-2	
R54	0684-1531			R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531	
R55	0684-5631			R: fxd 56 kΩ ±10% 1/4 W	01121	CB5631	
R56	0757-0793		1	R: fxd met flm 825 kΩ ±1% 1/4 W	19701	MF6C T-O	obd
R57	0684-2731			R: fxd 27 kΩ ±10% 1/4 W	01121	CB2731	
R58	0684-2231		1	R: fxd 22 kΩ ±10% 1/4 W	01121	CB2231	
R59	2100-0282			R: var ww 2000 Ω ±20% 1-1/2 W	71450	110	obd
R60	0698-3464			R: fxd met flm 1.47 MΩ ±10% 1/2 W	75042	CEC T-O	obd
R61	0684-1521		1	R: fxd comp 1500 kΩ ±10% 1/4 W	01121	CB1521	
R62	0757-0871			R: fxd met flm 1.21 MΩ ±1% 1/2 W	91637	MFF 1/2 T-O	obd
R63	0684-1531			R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1 (Cont'd)						
R64	0684-1231			R: fxd comp 12 kΩ ±10% 1/4 W	01121	CB1231
R65	0686-3325		1	R: fxd 3300 Ω ±5% 1/2 W	01121	EB3325
R66	0684-1021		1	R: fxd 1000 Ω ±10% 1/4 W	01121	CB1021
R67	0684-8221		1	R: fxd 8200 Ω ±10% 1/4 W	01121	CB8221
R68	0684-4721			R: fxd 4700 Ω ±10% 1/4 W	01121	CB4721
R69	0684-4711		1	R: fxd 470 Ω ±10% 1/4 W	01121	CB4711
R70	0683-2725		1	R: fxd comp 2700 Ω ±5% 1/4 W	01121	CB2725
R71	0757-0288		1	R: fxd met flm 9090 Ω ±1% 1/8 W	000LM	obd
R72	0757-0465		2	R: fxd met flm 100 kΩ ±1% 1/8 W	19701	MF5C T-O obd
R73	0698-4989		1	R: fxd met flm 1.18 MΩ ±1% 1/2 W	19701	MF5C T-O obd
R74	0698-3499		1	R: fxd met flm 40.2 kΩ ±1% 1/8 W	75042	CEA T-O obd
R75	0698-3228		1	R: fxd met flm 49.9 kΩ ±1% 1/8 W	19701	MF5C T-O obd
R76	0757-0465			R: fxd met flm 100 kΩ ±1% 1/8 W	19701	MF5C T-O obd
R77, R78	0684-1531			R: fxd 15 kΩ ±10% 1/4 W	01121	CB1531
R79	0684-1031			R: fxd 10 kΩ ±10% 1/4 W	01121	CB1031
R80	0684-4721			R: fxd 4700 Ω ±10% 1/4 W	01121	CB4721
R81	0684-1541			R: fxd 150 kΩ ±10% 1/4 W	01121	CB1541
R82	0687-1021		1	R: fxd 1000 Ω ±10% 1/2 W	01121	EB1021
R83	0698-4490		1	R: fxd 29.4 kΩ ±5% 1/4 W	91637	MFF-1/8 T-O
R84	2100-1770		1	R: var ww single turn 100 Ω ±10% 1/2 W	75042	Type 500
R85	0686-8255		1	R: fxd comp 8.2 MΩ ±5% 1/2 W	01121	EB8255
R86	0683-1025		1	R: fxd comp 1000 Ω ±5% 1/4 W	01121	CB1025
R87	0683-2705		1	R: fxd comp 27 Ω ±5% 1/4 W	01121	CB2705
R88	0683-1505		1	R: fxd comp 15 Ω ±5% 1/4 W	01121	CB1505
R89	0683-4725		1	R: fxd comp 4700 Ω ±5% 1/4 W	01121	CB4725
R90	0683-2215		1	R: fxd comp 220 Ω ±5% 1/4 W	01121	CB2215
A2	03430-66502		1	Assembly: Hundreds Decade Counter	-hp-	
A1 thru A5	1810-0005		13	Resistive network: 12 met flm	71590	obd
A6	1810-0006		3	Resistive network: 10 270 kΩ ±10%	56289	obd
C1	0140-0218		2	C: fxd mica 160 pF ±2%	04062	RDM15F161G3C
C2	0140-0217		3	C: fxd mica 140 pF ±2%	04062	RDM15F141G3C
C3	0140-0194		10	C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C4	0140-0217			C: fxd mica 140 pF ±2%	04062	RDM15F141G3C
C5, C6	0140-0198		17	C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C7	0160-0134		1	C: fxd mica 220 pF ±5%	14655	RDM15F221J3C
C8, C9	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C10	0140-0195		3	C: fxd mica 130 pF ±5%	04062	RDM15F131J3C
C11, C12	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C13	0160-0362			C: fxd mica 510 pF ±5%	04062	RDM15F511J3C
C14 thru C16	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C17	0160-0168		2	C: fxd 0.1 μF ±10%	56289	192P10492
CR1 thru CR8	1901-0025			Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
CR9 thru CR14	1910-0016		16	Diode: Ge	03877	S3185G
CR15 thru CR20	1901-0025			Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
DS1A thru DS1H	03430-88401		24	Lamp: neon matched set of 8	-hp-	
DS2	1970-0009		3	Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062		26	TSTR: Ge special 2N404	01295	GA287
Q9 thru Q15	1853-0016			TSTR: Si PNP 2N3638	07263	2N3638

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A2 (Cont'd)							
Q16 thru Q19	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q20, Q21	1850-0062			TSTR: Ge special 2N404	01295	GA287	
Q22	1853-0036			TSTR: Si PNP 2N3906	04713	2N3906	
Q23	1853-0016			TSTR: Si PNP 2N3638	07263	2N3638	
Q24	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q25	1853-0016			TSTR: Si PNP 2N3638	07263	2N3638	
Q26	1854-0022		3	TSTR: Si NPN**	-hp-		
Q27	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
R1	0683-1845		1	R: fxd comp 180 kΩ ±5% 1/4 W	01121	CB1845	
R2	0698-5143		1	R: fxd met flm 395 kΩ ±0.25% 1/8 W	75042	CEA T-2	
R3	0683-7535		3	R: fxd 75 kΩ ±5% 1/4 W	01121	CB7535	
R4	2100-0356		3	R: var ww 3000 Ω ±10% 1-1/2 W	71450	110	obd
R5	0684-3331			R: fxd comp 33 kΩ ±10% 1/4 W	01121	CB3331	
R6	2100-0330		2	R: var ww 1500 Ω ±10% 1-1/2 W	71450	110	obd
R7	0683-7535			R: fxd 75 kΩ ±5% 1/4 W	01121	CB7535	
R8	2100-0356			R: var ww 3000 Ω ±10% 1-1/2 W	71450	110	obd
R9	0698-5170		2	R: fxd met flm 198.5 kΩ ±0.5% 1/8 W	75042	CEA T-2	
R10	0684-5631			R: fxd 56 kΩ ±10% 1/4 W	01121	CB5631	
R11	0683-1045		2	R: fxd comp 100 kΩ ±5% 1/4 W	01121	CB1045	
R12	0811-1794			R: fxd ww 99.25 kΩ ±0.1% 1/40 W	05347	102A	
R13	0684-6831			R: fxd comp 68 kΩ ±10% 1/4 W	01121	CB6831	
R14	0683-5135		1	R: fxd 51 kΩ ±5% 1/4 W	01121	CB5135	
R15	0698-5170			R: fxd met flm 198.5 kΩ ±0.5% 1/8 W	75042	CEA T-2	
R16	0684-5631			R: fxd 56 kΩ ±10% 1/4 W	01121	CB5631	
R17	0683-1045			R: fxd comp 100 kΩ ±5% 1/4 W	01121	CB1045	
R18 thru R21	0684-3941		12	R: fxd 390 kΩ ±10% 1/4 W	01121	CB3941	
R22	0687-4731		3	R: fxd 47 kΩ ±10% 1/2 W	01121	EB4731	
R23, R24	0683-8225		6	R: fxd 8200 Ω ±5% 1/4 W	01121	CB8225	
R25	0684-6831			R: fxd comp 68 kΩ ±10% 1/4 W	01121	CB6831	
R26	0683-6845		1	R: fxd 680 kΩ ±5% 1/4 W	01121	CB6845	
R27	0683-2745		1	R: fxd comp 270 kΩ ±5% 1/4 W	01121	CB2745	
R28	0686-2445		1	R: fxd 240 kΩ ±5% 1/2 W	01121	EB2445	
R29	0683-5145		1	R: fxd 510 kΩ ±5% 1/4 W	01121	CB5145	
R30, R31	0683-1835		2	R: fxd 18 kΩ ±5% 1/4 W	01121	CB1835	
R32	0683-7535			R: fxd 75 kΩ ±5% 1/4 W	01121	CB7535	
R33	0684-1231			R: fxd comp 12 kΩ ±10% 1/4 W	01121	CB1231	
R34	0683-3035		1	R: fxd 30 kΩ ±5% 1/4 W	01121	CB3035	
R35	0811-1792		1	R: fxd ww 66.2 kΩ ±0.1% 1/2 W	05347	102A	
R36	2100-0330			R: var ww 1500 Ω ±10% 1-1/2 W	71450	110	obd
R37	0684-3331			R: fxd comp 33 kΩ ±10% 1/4 W	01121	CB3331	
R38	0683-1835			R: fxd 18 kΩ ±5% 1/4 W	01121	CB1835	
R39	2100-0396		2	R: var ww 10 kΩ ±20% 1-1/2 W	71450	110	obd
S1	3101-0961		1	Switch: slide TEST/OPERATE	79727	G-124-PC	
MP1	5040-0641		3	Socket: indicator tube	-hp-		
MP2	5040-0696		3	Block: photoconductor	-hp-		
MP3	5040-4501		3	Gasket: photoconductor block	-hp-		
MP4	05212-0011		3	Shield: transparent	-hp-		
MP5	1990-0009		3	Plate: photoconductor matrix	-hp-		
MP6	1400-0283		30	Spring Clip	-hp-		
MP7	5212A-83C		3	Cover	-hp-		
A3	03430-66503		1	Assembly: Tens Decade	-hp-		
A1 thru A4	1810-0005			Resistive network: 12 met flm	71590	obd	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
A3 (Cont'd)						
A5	1810-0006			Resistive network: 10 270 kΩ ±10%	56289	obd
C1	0140-0218			C: fxd mica 160 pF ±2%	04062	RDM15F161G3C
C2	0140-0217			C: fxd mica 140 pF ±2%	04062	RDM15F141G3C
C3	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C4	0140-0176			C: fxd mica 100 pF ±2%	04062	RDM15F101G3C
C5 thru C7	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C8, C9	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C10	0140-0195			C: fxd mica 130 pF ±5%	04062	RDM15F131J3C
C11, C12	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C13	0160-0362			C: fxd mica 510 pF ±5%	04062	RDM15F241J3C
CR1 thru CR8	1901-0025			Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
CR9 thru CR13	1910-0016			Diode: Ge	03877	S3185G
DS1A thru DS1H	03430-88401			Lamp: neon matched set of 8	-hp-	
DS2	1970-0009			Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062			TSTR: Ge special 2N404	01295	GA287
Q9 thru Q12	03430-82501		8	TSTR: low leakage	-hp-	
R1	0684-1041		8	R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R2	0727-0849		2	R: fxd 2 MΩ ±1% 1/2 W	75042	CEA T-O obd
R3	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R4	0698-5159		4	R: fxd met flm 1 MΩ ±0.5% 1/4 W	75042	CEA T-O obd
R5	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R6	0698-5157		2	R: fxd met flm 500 kΩ ±0.25% 1/4 W	75042	CEA T-O obd
R7	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R8	0698-5159			R: fxd met flm 1 MΩ ±0.5% 1/4 W	75042	CEA T-O obd
R9	0683-1125		2	R: fxd 1100 Ω ±5% 1/4 W	01121	CB1125
R10	0727-0849			R: fxd 2 MΩ ±1% 1/2 W	75042	CEA T-O obd
R11	0698-5159			R: fxd met flm 1 MΩ ±0.5% 1/4 W	75042	CEA T-O obd
R12	0698-5157			R: fxd met flm 500 kΩ ±0.25% 1/4 W	75042	CEA T-O obd
R13	0698-5159			R: fxd met flm 1 MΩ ±0.5% 1/4 W	75042	CEA T-O obd
R14	0684-0271		4	R: fxd 2.7 Ω ±10% 1/4 W	01121	CB27G1
R15 thru R18	0684-3941			R: fxd 390 kΩ ±10% 1/4 W	01121	CB3941
R19	0687-4731			R: fxd 47 kΩ ±10% 1/2 W	01121	EB4731
R20, R21	0683-8225			R: fxd 8200 Ω ±5% 1/4 W	01121	CB8225
R22	0684-6831			R: fxd comp 68 kΩ ±10% 1/4 W	01121	CB6831
MP1	5040-0641			Socket: indicator tube	-hp-	
MP2	5040-0696			Block: photoconductor	-hp-	
MP3	5040-4501			Gasket: photoconductor block	-hp-	
MP4	05212-0011			Shield: transparent	-hp-	
MP5	1990-0009			Plate: photoconductor matrix	-hp-	
MP6	1400-0283			Spring Clip	-hp-	
MP7	5212A-83C			Cover	-hp-	
A4	03430-66504		1	Assembly: Units Decade	-hp-	
A1 thru A4	1810-0005			Resistive network: 12 met flm	71590	obd
A5	1810-0006			Resistive network: 10 270 kΩ ±10%	56289	obd
C1	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C2	0140-0217			C: fxd mica 140 pF ±2%	04062	RDM15F141G3C
C3	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
A4 (Cont'd)						
C4	0140-0217			C: fxd mica 140 pF ±2%	04062	RDM15F141G3C
C5 thru C7	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C8, C9	0140-0194			C: fxd mica 110 pF ±5%	04062	RDM15F111J3C
C10	0140-0195			C: fxd 130 pF	04062	RDM15F131J3C
C11, C12	0140-0198			C: fxd mica 200 pF ±5%	04062	RDM15F201J3C
C13	0160-0362			C: fxd mica 510 pF ±5%	04062	RDM15F511J3C
CR1 thru CR8	1901-0025			Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
CR9 thru CR13	1910-0016			Diode: Ge	03877	S3185G
DS1A thru DS1H	03430-84401			Lamp: neon matched set of 8	-hp-	
DS2	1970-0009			Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062			TSTR: Ge special 2N404	01295	GA287
Q9 thru Q12	03430-82501			TSTR: low leakage	-hp-	
R1	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R2	0683-2055			R: fxd comp 2 MΩ ±5% 1/4 W	01121	CB2055
R3	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R4	0683-1055		4	R: fxd 1 MΩ ±5% 1/4 W	01121	CB1055
R5	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R6	0757-0327		2	R: fxd met flm 499 kΩ ±1% 1/4 W	75042	obd
R7	0684-1041			R: fxd 100 kΩ ±10% 1/4 W	01121	CB1041
R8	0683-1055			R: fxd 1 MΩ ±5% 1/4 W	01121	CB1055
R9	0683-1125			R: fxd 1100 Ω ±5% 1/4 W	01121	CB1125
R10	0683-2055			R: fxd 2 MΩ ±5% 1/4 W	01121	CB2055
R11	0683-1055			R: fxd 1 MΩ ±5% 1/4 W	01121	CB1055
R12	0757-0327			R: fxd met flm 499 kΩ ±1% 1/4 W	75042	CEC T-O obd
R13	0683-1055			R: fxd 1 MΩ ±5% 1/4 W	01121	CB1055
R14	0684-0271			R: fxd 2.7 Ω ±10% 1/4 W	01121	CB27G1
R15 thru R18	0684-3941			R: fxd 390 kΩ ±10% 1/4 W	01121	CB3941
R19	0687-4731			R: fxd 47 kΩ ±10% 1/2 W	01121	EB4731
R20, R21	0683-8225			R: fxd 8200 Ω ±5% 1/4 W	01121	CB8225
R22	0684-6831			R: fxd comp 68 kΩ ±10% 1/4 W	01121	CB6831
R23	0698-0025		1	R: fxd met flm 17.8 kΩ ±1% 1/2 W	000LM	obd
R24	0757-0824		1	R: fxd met flm 2000 Ω ±1% 1/2 W	75042	CEC T-O obd
MP1	5040-0641			Socket: indicator tube	-hp-	
MP2	5040-0696			Block: photoconductor	-hp-	
MP3	5040-4501			Gasket: photoconductor block	-hp-	
MP4	05212-0011			Shield: transparent	-hp-	
MP5	1990-0009			Plate: photoconductor matrix	-hp-	
MP6	1400-0283			Spring Clip	-hp-	
MP7	5212A-83C			Cover	-hp-	
A5	03430-66505		1	Assembly: Regulator	-hp-	
C1	0180-0050		1	C: fxd Al elect 40 μF +100% -15% 50 vdcw	56289	30D406G050DF-6M1
C2				Not assigned		
C3	0180-0039		1	C: fxd Al elect 100 μF +75% -10% 12 vdcw	56289	30D107G012CC-2-DSM
C4	0180-0094		1	C: fxd Al elect 100 μF +75% -10% 25 vdcw	56289	30D107G025DD2-DSM
C5	0170-0038		1	C: fxd my 0.22 μF ±10% 200 vdcw	56289	type 148P #148-P22492

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A5 (Cont'd)							
C6	0160-0945		2	C: fxd mica 910 pF ±5%	04062	RDM15F911J1C	
C7	0160-0154		2	C: fxd my 0.0022 μF ±10% 200 vdcw	56289	192P22292-PTS	
C8	0160-0945			C: fxd mica 910 pF ±5%	04062	RDM15F911J1C	
C9	0160-0154			C: fxd my 0.0022 μF ±10% 200 vdcw	56289	192P22292-PTS	
CR1 thru CR6	1901-0025			Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072	
CR7	1902-0071		1	Diode: Si breakdown 9.0 V ±5%	04713	obd	
CR8	1902-0556		1	Diode: breakdown 20.0 V ±5%	75042	obd	
CR9 thru CR12	1901-0029		4	Diode: Si 600 piv	04713	SR1358-10	
CR13 thru CR18	1901-0026		6	Diode: Si 200 piv	04713	SR1358-8	
Q1	1854-0039		1	TSTR: Si NPN 2N3053	86684	2N3053	
Q2, Q3	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122	
Q4, Q5				Not assigned			
Q6	1853-0001		1	TSTR: Si PNP**	-hp-		
Q7, Q8	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q9	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122	
Q10, Q11	1854-0022			TSTR: **	-hp-		
Q12	1853-0036			TSTR: Si PNP 2N4122	07263	2N4122	
Q13, Q14	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
R1	0684-0271			R: fxd 2.7 Ω ±10% 1/4 W	01121	CB27G1	
R2	0684-2241			R: fxd comp 220 kΩ ±10% 1/4 W	01121	CB2241	
R3	0698-4892		1	R: fxd met flm 1.87 kΩ ±1% 1/2 W	75042	CEA T-O	obd
R4	0698-0026		1	R: fxd met ox 1690 Ω ±5% 1/2 W	19701	MF7C T-O	obd
R5	0698-4657		1	R: fxd met flm 7150 Ω ±1% 1/4 W	19701	MF6C T-O	obd
R6				Not assigned			
R7	0698-4898		1	R: fxd 2800 Ω ±1% 1/2 W	91637	MFF-1/2 T-O	obd
R8 thru R10				Not assigned			
R11	0683-0335		2	R: fxd comp 3.3 Ω ±5% 1/4 W	01121	CB33G5	
R12	0698-4652		1	R: fxd met flm 5760 Ω ±1% 1/4 W	19701	MF6C T-O	obd
R13	0757-0739		1	R: fxd 2000 Ω ±1% 1/4 W	19701	MF6C T-O	obd
R14				Not assigned			
R15	0698-3346		1	R: fxd met flm 4220 Ω ±1% 1/2 W	75042	CEC T-O	obd
R16	0684-5601		1	R: fxd 56 Ω ±10% 1/4 W	01121	CB5601	
R17	0684-1031			R: fxd 10 kΩ ±10% 1/4 W	01121	CB1031	
R18	0757-0782		1	R: fxd met flm 200 kΩ ±1% 1/4 W	19701	MF6C T-O	obd
R19	0757-0341		1	R: fxd met flm 30.1 kΩ ±1% 1/4 W	19701	MF6C T-O	obd
R20	2100-0328		1	R: var ww 500 Ω ±10% 1-1/2 W	71450	110	obd
R21	0698-4702		1	R: fxd met flm 8450 Ω ±1% 1/4 W	91637	MFF-1/4 T-O	obd
R22	0764-0015		1	R: fxd 560 Ω ±5% 2 W	07115	C-42S	obd
R23	0757-0464		1	R: fxd 90.9 kΩ ±1% 1/8 W	19701	MF7C T-9	
R24	0698-4735		1	R: fxd met flm 34.0 kΩ ±1% 1/4 W	91637	MFF-1/4 T-O	obd
R25				Not assigned			
R26	0698-4036		1	R: fxd met flm 16.9 kΩ ±1% 1/4 W	19701	MF6C T-O	obd
R27	0684-0271			R: fxd 2.7 Ω ±10% 1/4 W	01121	CB27G1	
R28	0683-0335			R: fxd comp 3.3 Ω ±5% 1/4 W	01121	CB33G5	
MP1	1205-0033		2	Heat sink: semiconductor used with A5Q1 and A5Q6	05820	NF-207	
A6	03430-66506		1	Assembly: Attenuator	-hp-		
R1	0727-0262		1	R: fxd prec 900 kΩ ±0.5% 1/2 W	91637	DCS1/2	
R2	03430-82602		1	R: fxd met flm 8.94 MΩ ±0.25% 1 W	-hp-		
R3*				See Paragraph 5-75			
R4	2100-0396			R: var ww 10 kΩ ±20% 1-1/2 W	71450	110	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A6 (Cont'd)							
R5	0698-5158		1	R: fxd 894 kΩ ±1% 1/4 W	75042	CEC T-9	
R6	2100-0282			R: var ww 2000 Ω ±20% 1-1/2 W	71450	110	obd
R7	0683-8245		1	R: fxd 820 kΩ ±5% 1/4 W	01121	CB8245	
R8	0811-1793		1	R: fxd ww 88.9 kΩ ±0.1%	05347	102A	obd
R9	2100-0439		1	R: var ww 250 Ω ±20% 1-1/2 W	71450	110	obd
R10	0683-9145		2	R: fxd 910 kΩ ±5% 1/4 W	01121	CB9145	
R11	0811-1790		1	R: fxd ww 8860 Ω ±1%	05347	102A	obd
R12	2100-1560			R: var ww 30 Ω ±10% 1-1/2 W	11236	110	obd
R13	0683-9145			R: fxd 910 kΩ ±5% 1/4 W	01121	CB9145	
R14	0811-1789			R: fxd prec ww 985 Ω ±0.1% 1/2 W	05347	102A	obd
A7	03430-66507		1	Assembly: Ratio (Option 01 only)	-hp-		
C1	0160-0194		1	C: fxd my 0.015 μF ±10% 200 vdcw	56289	192P15392-PTS	
C2				Not assigned			
C3	0160-0166		1	C: fxd my 0.068 μF ±10% 200 vdcw	56289	192P68392-PTS	
C4	0160-0168			C: fxd 0.1 μF ±10%	56289	192P10492-PTS	
CR1, CR2	1901-0156			Diode: Si 50 mA at + 1 V 20 wiv	01281	PS5553	
CR3	1901-0025			Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072	
Q1A,B	1855-0036			TSTR: F.E.T. dual	15818	SU2119	
Q2	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q3, Q4	1854-0266			TSTR: NPN 2N3711	01295	obd	
Q5	1854-0071			TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q6	1853-0036			TSTR: Si PNP 2N3906	04713	2N3906	
R1	0757-0482		1	R: fxd met flm 511 kΩ ±1% 1/8 W	000LM	obd	
R2	0684-2241			R: fxd comp 220 kΩ ±10% 1/4 W	01121	CB2241	
R3	0757-0438		1	R: fxd met flm 5.11 kΩ ±1% 1/8 W	75042	CEA T-O	obd
R4	2100-0356			R: var ww 3000 Ω ±10% 1-1/2 W	71450	110	obd
R5	0698-5450		1	R: fxd met flm 50 kΩ ±0.1% 1/8 W	75042	CEA T-O	obd
R6	0698-3457		1	R: fxd met flm 316 kΩ ±1% 1/8 W	000LM	obd	
R7	0698-3159		1	R: fxd met flm 26.1 kΩ ±1% 1/8 W	000LM	obd	
R8	0757-0274		1	R: fxd met flm 1210 Ω ±1% 1/8 W	000LM	obd	
R9, R10	0757-0466		3	R: fxd met flm 110 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R11	2100-0281		1	R: var ww single turn 100 Ω ±20% 1-1/2 W	11237	110	obd
R12*				See Paragraph 5-78			
R13, R14	0698-3260		2	R: fxd met flm 464 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R15	0757-0466			R: fxd met flm 110 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R16	0698-3160			R: fxd met flm 31.6 kΩ ±1% 1/8 W	19701	MF5C T-O	obd
R17	0757-0441		1	R: fxd met flm 8250 Ω ±1% 1/8 W	19701	MF5C T-O	obd
R18	0698-5171		1	R: fxd met flm 400 kΩ ±0.1% 1/8 W	75042	CEA T-O	obd
R19*				See Paragraph 5-79			
R20	2100-0396			R: var ww 10 kΩ ±20% 1-1/2 W	71450	110	obd
R21	0686-4725			R: fxd 4700 Ω ±5% 1/2 W	01121	EB4725	
R22	0757-0395		1	R: fxd met flm 56.2 Ω 1/8 W	91637	MFF-1/8 T-O	obd
R23	0686-1505		1	R: fxd comp 15 Ω ±5% 1/2 W	01121	EB1505	
R24	0757-0458		1	R: fxd met flm 51.1 kΩ ±1% 1/8 W	91637	MFF-1/8 T-O	obd
C1, C2	0180-0107		2	C: fxd 20 μF +100% -10% 200 vdcw	56289	D34154	
C3	0180-0148		1	C: fxd 890 μF +100% -10% 15 vdcw	56289	D37921	
C4	0180-0056		1	C: fxd 1000 μF 50 vdcw	56289	D32429	
C5	0180-0353		1	C: fxd 450 μF +100% -10% 50 vdcw	56289	D38702	
C6	0170-0022		1	C: fxd my 0.1 μF ±20% 600 vdcw	000LH	HEW-17	
DS1, DS2	2140-0015		4	Lamp: glow neon	24446	NE2E4	obd
DS3 thru DS5	2140-0028		3	Lamp: glow neon	24446	NE2E4	obd
DS6, DS7	2140-0073		2	Lamp: incandescent	71744	CM8-627	
DS8	2140-0015			Lamp: glow neon OVERRANGE	24446	NE2E4	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
DS9	2140-0015			Lamp: glow neon RATIO (Option 01 only)	24446	NE2E4	obd
F1	2110-0044		1	Fuse: cartridge 0.3 amp slow-blow	75915	313.300	
J1	1251-1450		5	Connector: 22 pin female connector for A1, A2, A3, A4 and A5	95354	178-100-07	
J2	1251-1451		1	Connector: 22 pin female connector for A2	95354	176-100-07	
J3 thru J5	1251-1450			Connector: 22 pin female connector for A1, A2, A3, A4 and A5	95354	178-100-07	
J6				Terminal Set: INPUT, see MP1, MP2, MP5			
J7	1251-1450			Connector: 22 pin female connector for A7 (Option 01 only)	95354	178-100-07	
J8				Terminal Set: AMPLIFIER OUTPUT and RATIO INPUT (Option 01 only)			
R1, R2	0686-4735		3	R: fxd 47 kΩ ±5% 1/2 W	01121	EB4735	
R3	0757-0818		1	R: fxd 825 Ω ±1% 1/2 W	75042	CEC T-O	obd
R4	2100-2034		1	R: var lin ww ~~ten turn~~ 10 Ω ±10%	71450	VA-45	
R5	0767-0001		1	R: fxd 400 Ω ±5% 3 W	07115	LP1-3	
R6, R7	0687-1041		2	R: fxd 100 kΩ ±10% 1/2 W	01121	EB1041	
R8	0686-4735			R: fxd comp 47 kΩ ±5% 1/2 W (Option 01 only)	01121	CB4735	
R9	0687-3931		1	R: fxd comp 39 kΩ ±10% 1/2 W	01121	EB3931	
S1	3100-1736		1	Switch: rotary, RANGE	76854	obd	
S2	3101-0001		1	Switch: SPST toggle	04009	80994-HB	
S3	3101-0033		1	Switch: 115/230 slide SPDT miniature	82389	11A-1009	
S4, S5	3101-0070		2	Switch: slide DPDT miniature (Option 01 only)	79727	G-126	
T1	9100-1339		1	Transformer: power	-hp-		
XF1	1400-0084		1	Holder: fuse	75915	342014	

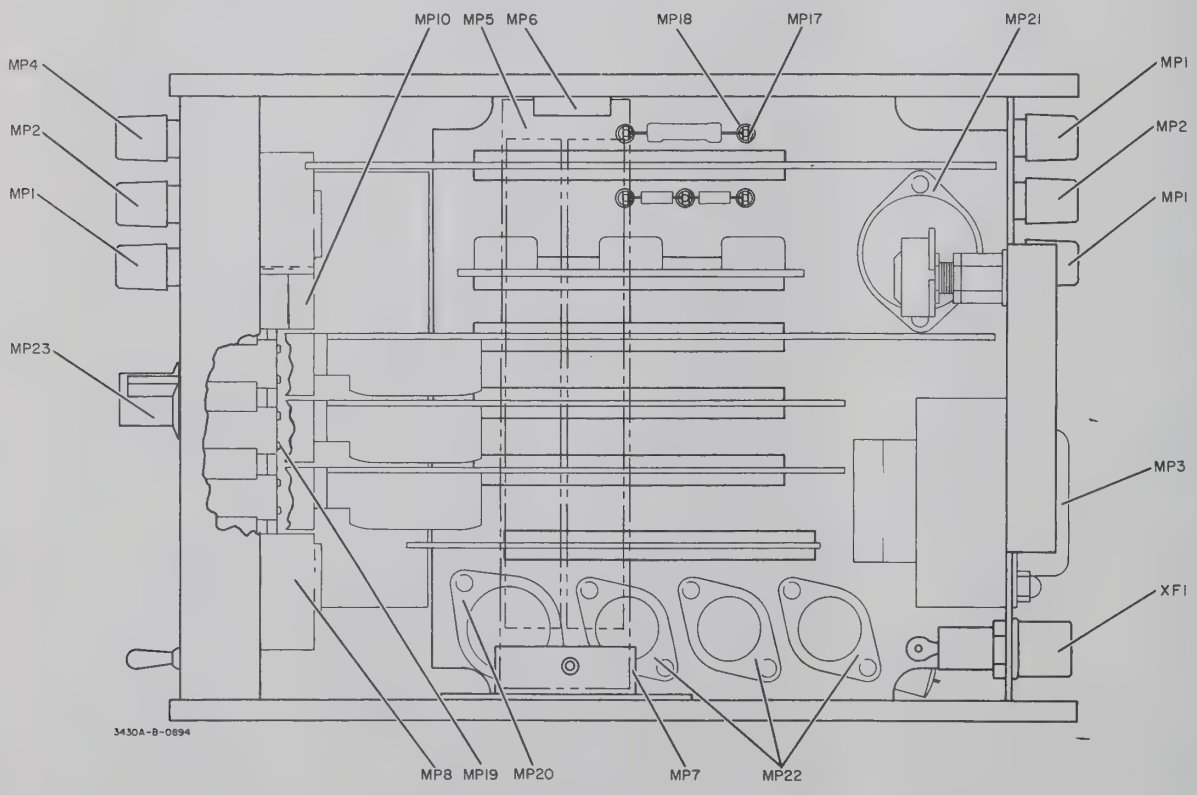


Figure 6-3. Miscellaneous Chassis Parts

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
				MISCELLANEOUS PARTS SEE FIGURE 6-3		
MP1	1510-0008		3	Binding post assembly: red	-hp-	
MP2	1510-0009		2	Binding post assembly: black w/o solder turret	-hp-	
MP3	7100-0120		1	Cover: half shell	04842	Size 1 Std. H
MP4	5060-0625		1	Binding post: black	-hp-	
MP5	5040-4563		1	Hold down bar	-hp-	
	2460-0028		1	Screw: Phillips 9/16 in. (for hold down bar)	80120	obd
	2190-0006		1	Lock washer: (for hold down bar)	80120	obd
	3050-0010		1	Flat washer: (for hold down bar)	000LI	obd
MP6	5020-5309		1	Retainer	-hp-	
MP7	03430-01202		1	Bracket	-hp-	
MP8	5040-4510		1	Annunciator and Decimal Holder	-hp-	
MP9				Not assigned		
MP10	5040-0695		1	Readout block: Digit	-hp-	
MP11, MP12				Not assigned		
MP13	5040-0693		1	Insert: digit readout	-hp-	
MP14	5020-0687		1	Polarity readout	-hp-	
MP15	5000-2839		6	Partition: annunciator	-hp-	
MP16	03430-24301		1	Function readout	-hp-	
MP17	0340-0038		5	Post: terminal	00866	HP-3000 M-3
MP18	0340-0039		11	Insulator: bushing	00866	HP-3000 T-1
MP19	0340-0037		6	Post: terminal-turret	98291	X-L041762-9
MP20	1520-0002		1	Plate: mounting	56137	obd
MP21	1520-0001		1	Plate: mounting	56137	Grade X-831
MP22	1520-0003		3	Plate: mounting	37942	obd
MP23	0370-0112		1	Knob: black w/one arrow p/o S1	-hp-	
MP24	1251-0148		1	Connector: power 3 female contacts	71468	MS3102R14S-7S(c)
MP25	8120-0078		1	Cord set: power	70903	KH-4147
MP26	03430-90001		1	Manual: Operating and Service	-hp-	

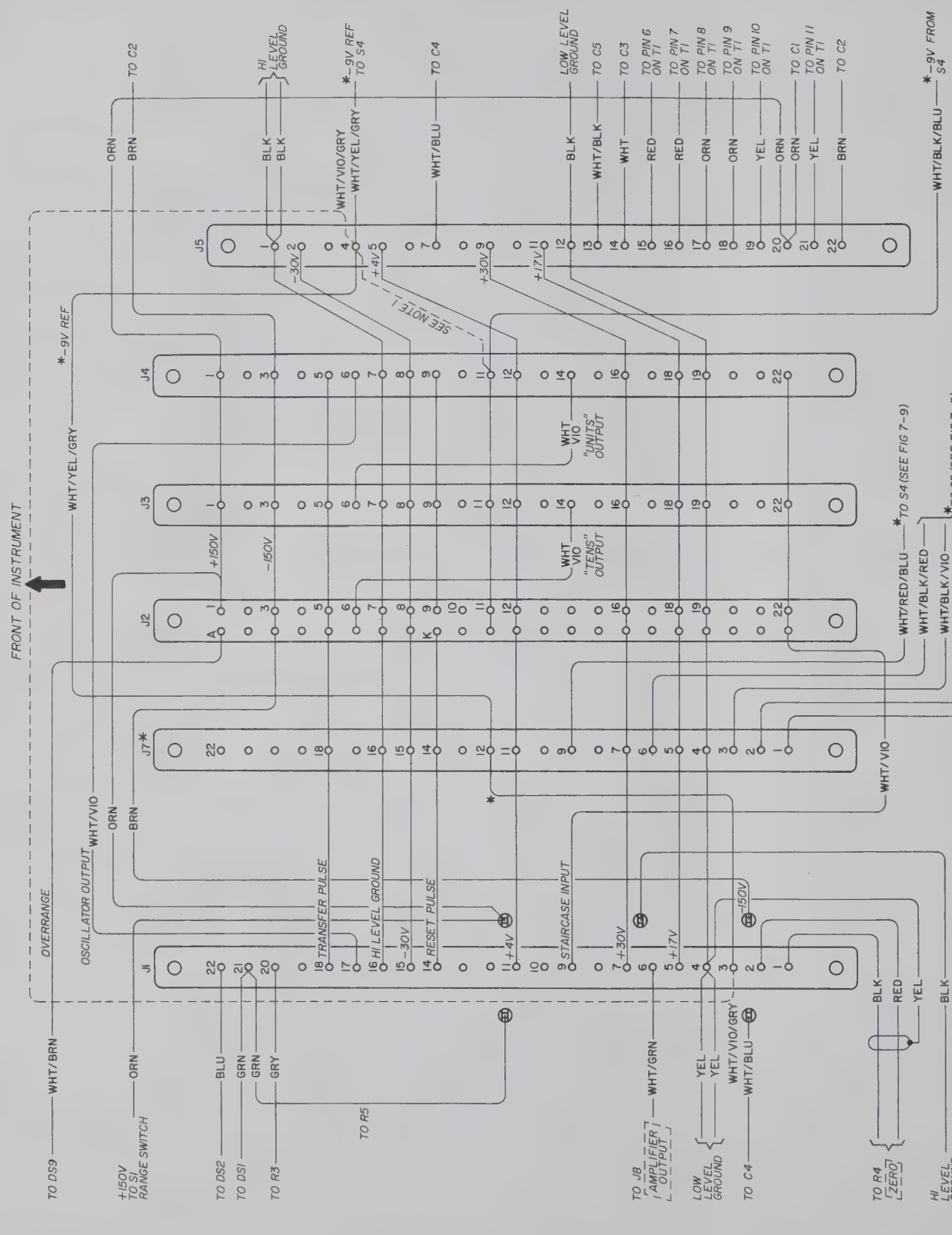


Figure 7-1A. Wiring Diagram

SECTION VII
CIRCUIT DIAGRAMS

7-1. INTRODUCTION.

7-2. This section contains the diagrams necessary to maintain the Model 3430A. Both pictorial views of the circuit boards, and schematic diagrams are included. Figure 7-1A is a wiring diagram, and 7-1B shows the location of circuit boards and chassis mounted components. Figure 7-2 contains a block diagram. Figure 7-3A applies to instruments with serial numbers 723-01001 and above. Figure 7-3B applies to instruments with serial numbers 723-01000 and below and instruments with serial numbers prefixed 641-.

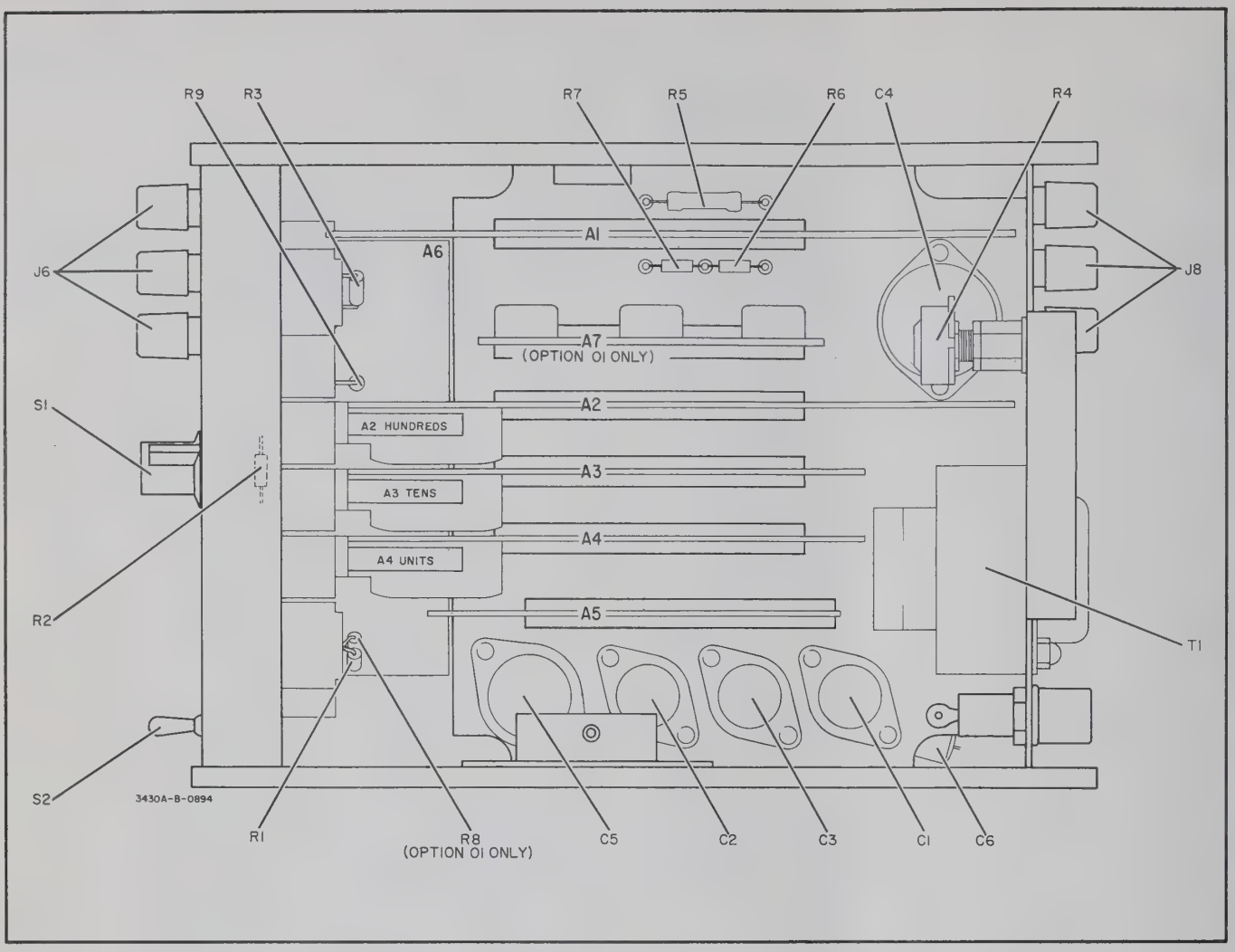
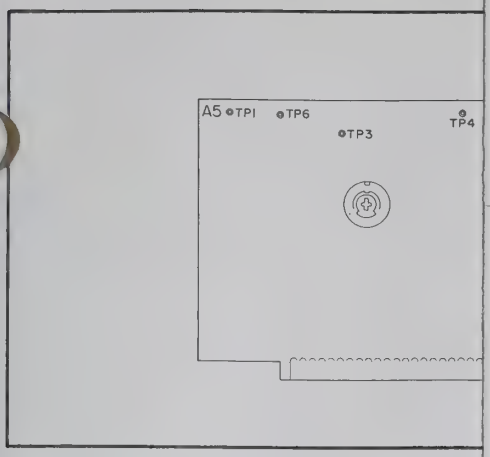


Figure 7-1B. Location of Chassis Mounted Components



Power Supply Voltages

Test Point	Voltage (115 V Line)	Typical Varia with ±10% Li Voltage Chan
A5TP1	-30.00 ± 0.02 V	± 0.05 V
A5TP3	- 9.00 ± 0.50 V	± 0.002 V
A5TP4	+30.00 ± 0.90 V	± 0.02 V
A5TP5	+17.00 ± 0.50 V	± 0.01 V
A5TP6	+ 4.00 ± 0.12 V	± 0.008 V

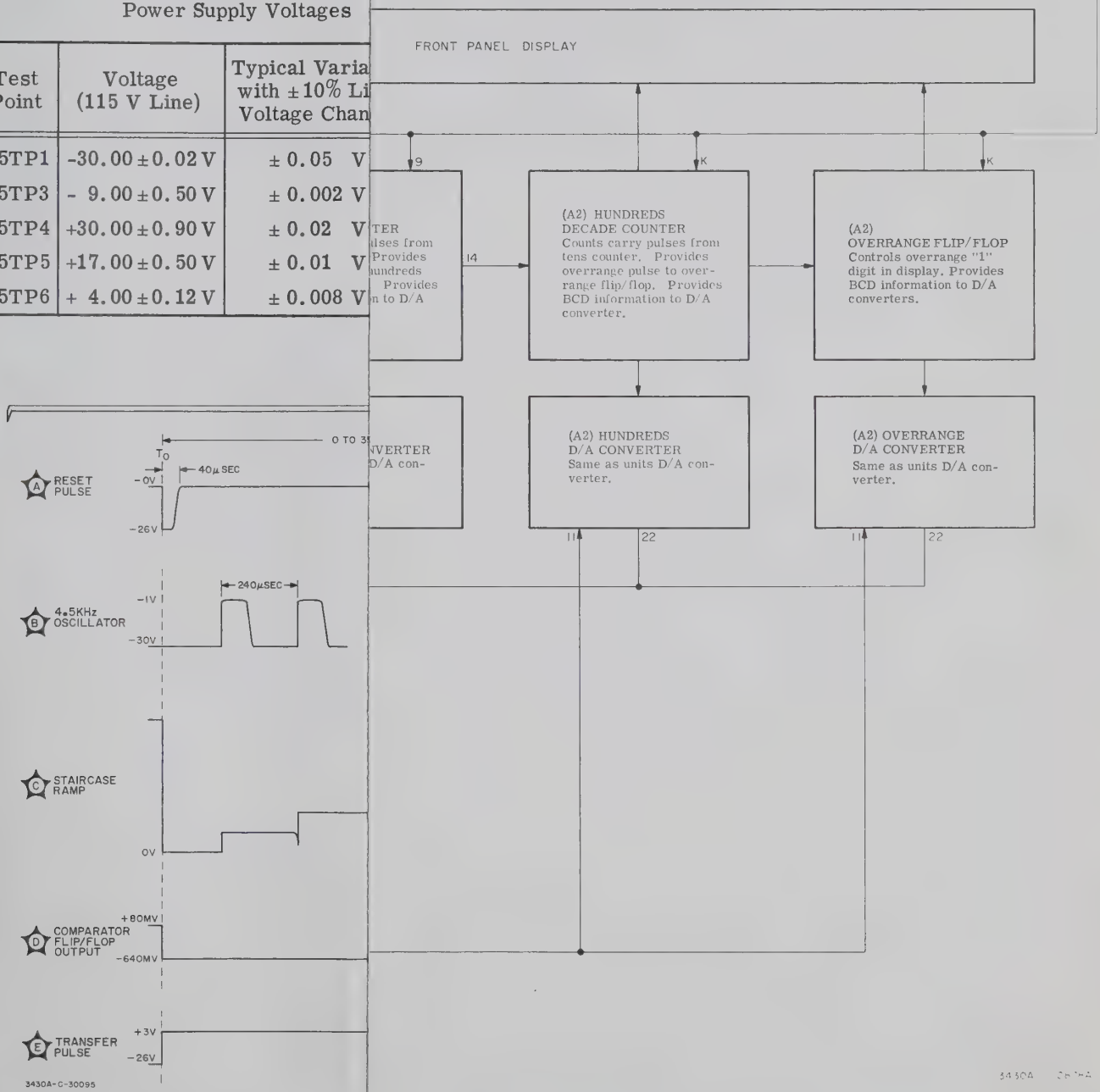


Figure 7-2. Block Diagram and Waveforms

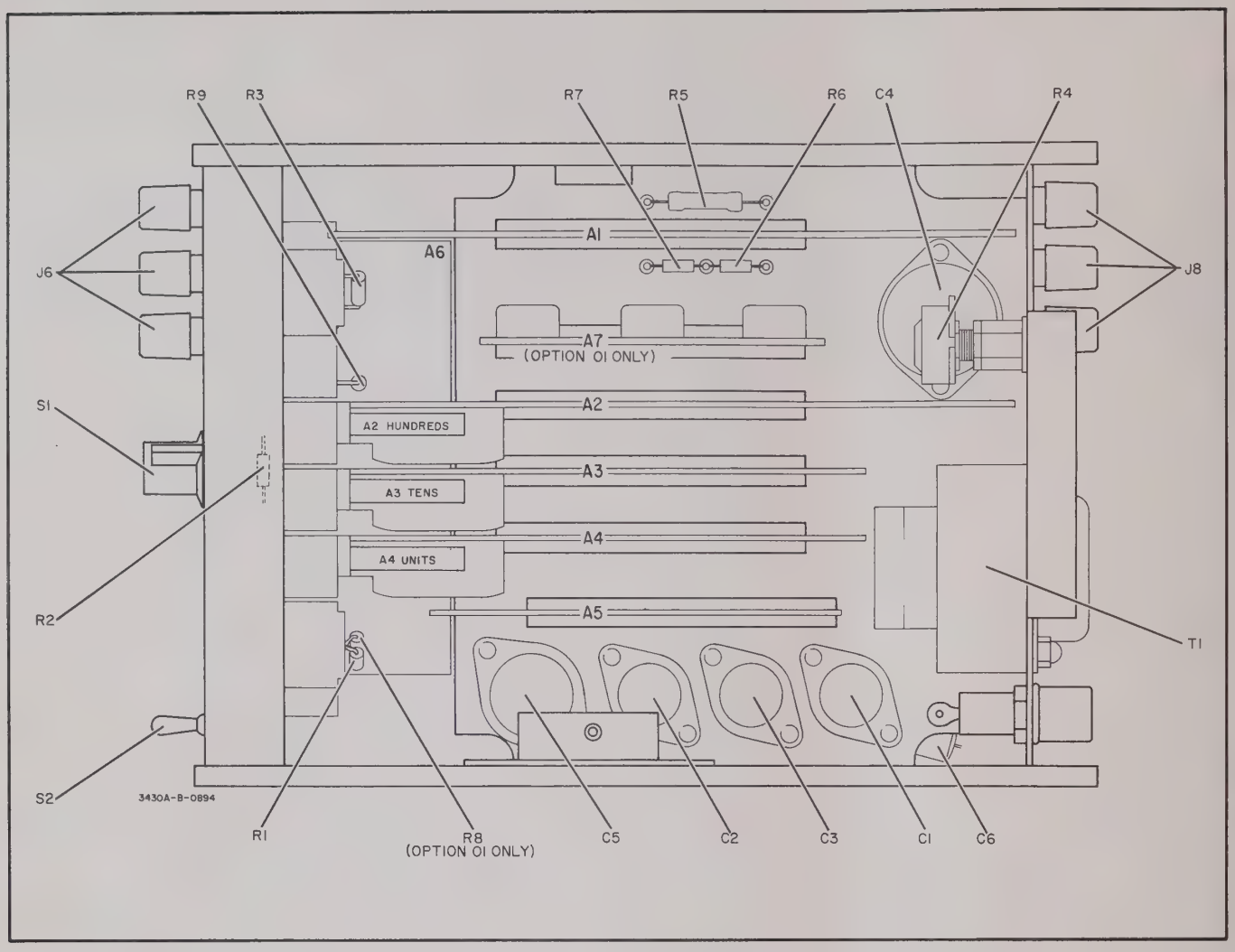
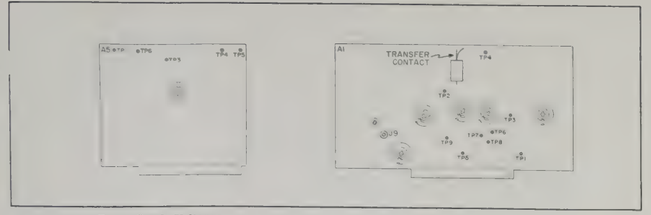


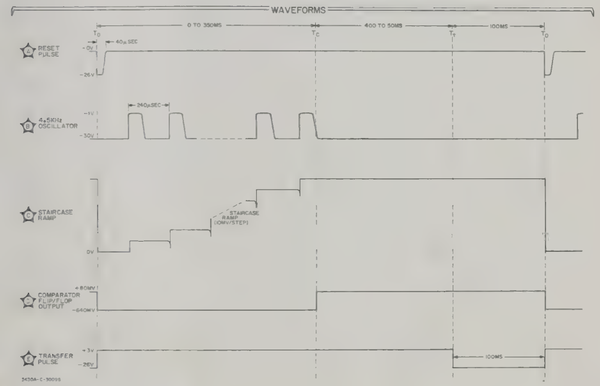
Figure 7-1B. Location of Chassis Mounted Components



Power Supply Voltages

Test Point	Voltage (115 V Line)	Typical Variation with ±10% Line Voltage Change	Typical Ripple
A5TP1	-30.00±0.02 V	± 0.05 V	10 mV p-p
A5TP3	- 9.00±0.50 V	± 0.002 V	5 mV p-p
A5TP4	+30.00±0.90 V	± 0.02 V	5 mV p-p
A5TP5	+17.00±0.50 V	± 0.01 V	5 mV p-p
A5TP6	+ 4.00±0.12 V	± 0.008 V	2 mV p-p

For a detailed block diagram analysis, see Section IV of this manual.



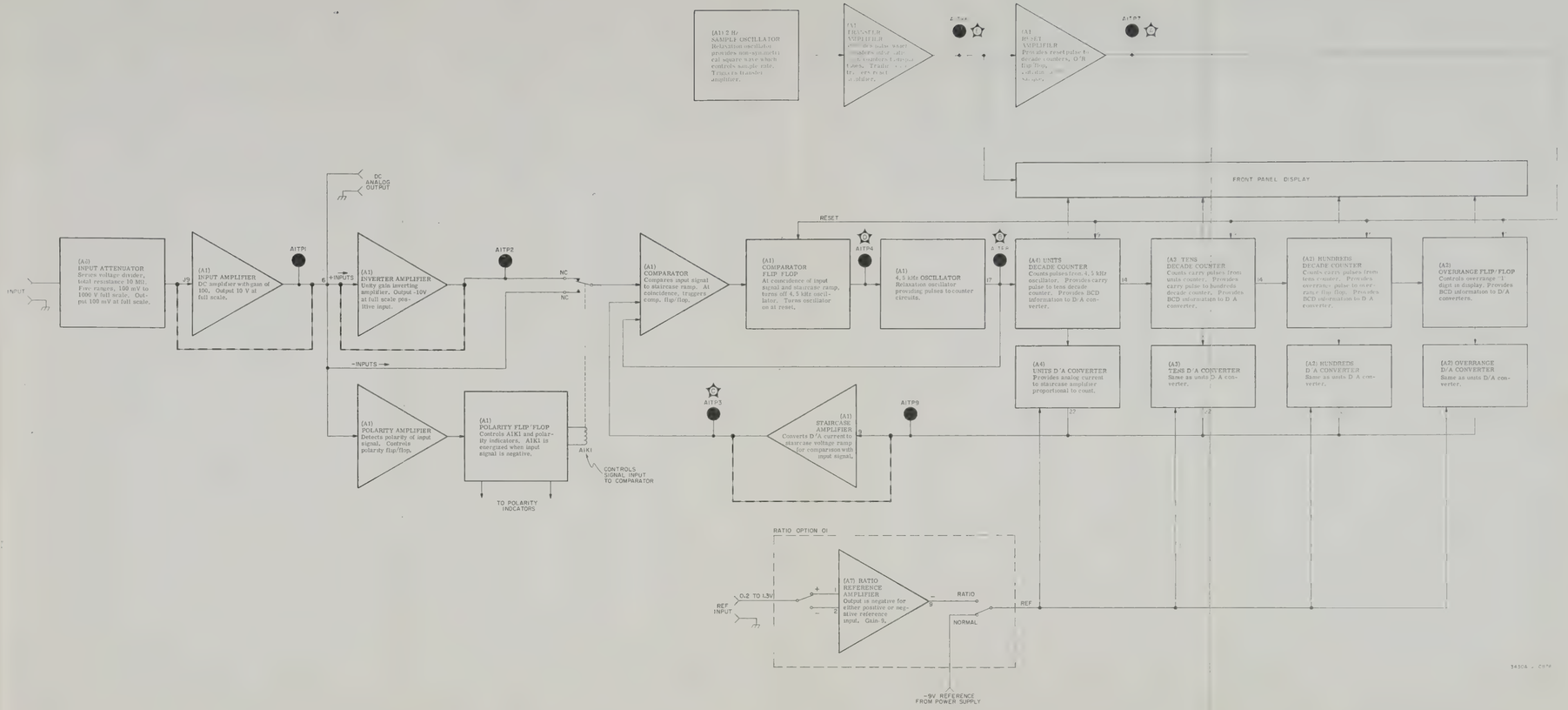


Figure 7-2. Block Diagram and Waveforms

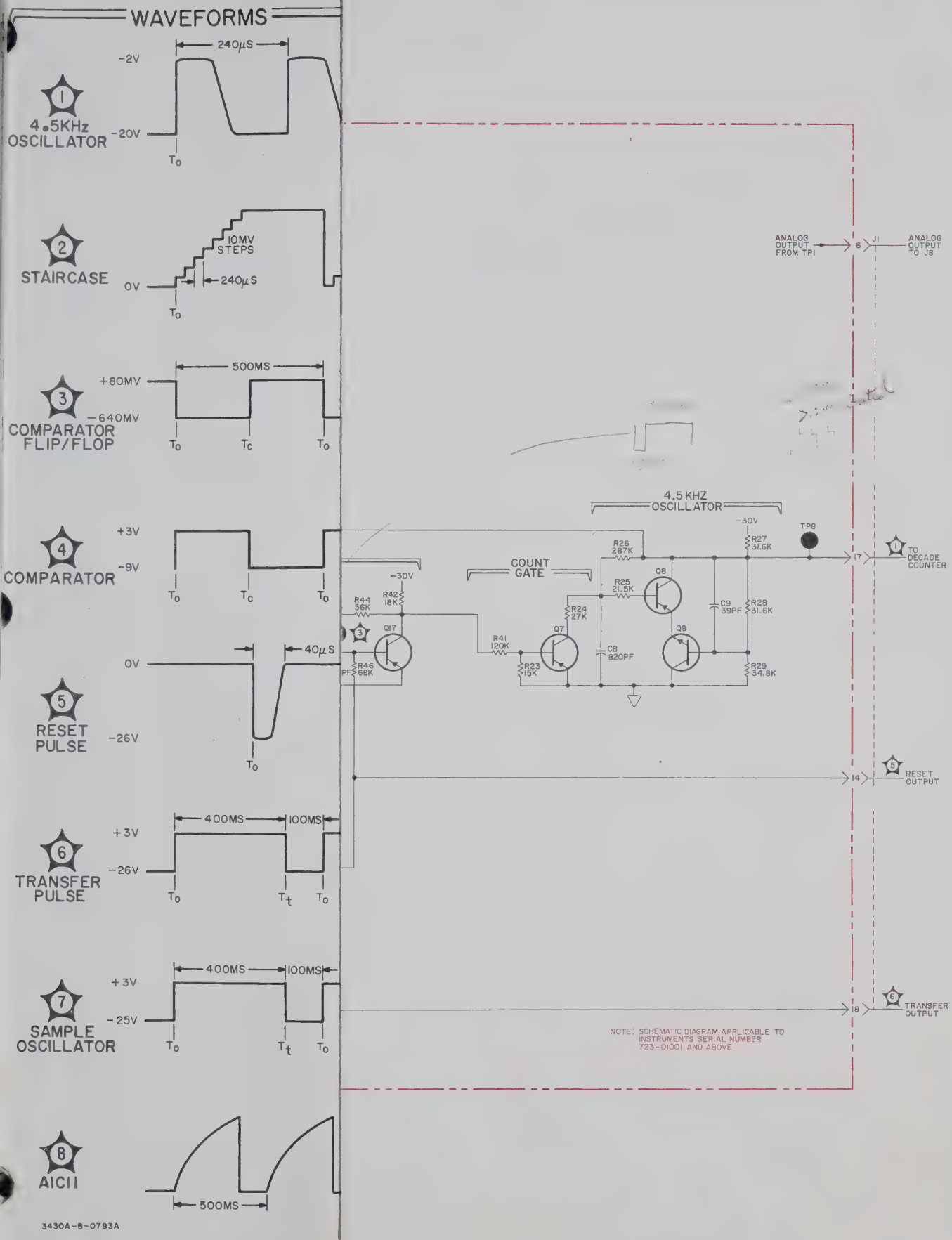
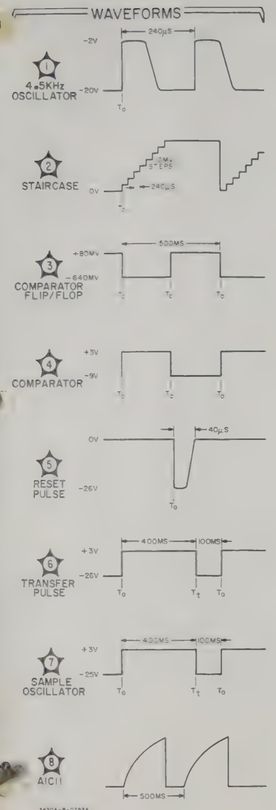


Figure 7-3A. Schematic Diagram, A1 Amplifier Assembly

WAVEFORMS

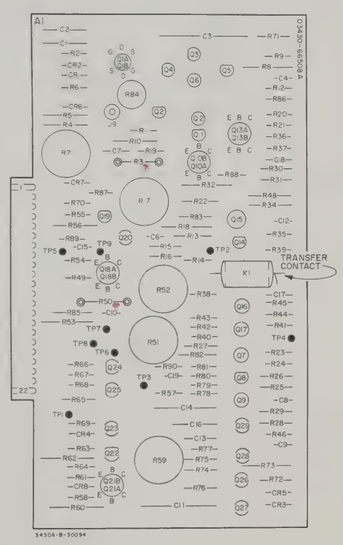


NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ☆ DENOTES WAVESHAPE. SEE WAVESHAPE DRAWING.
4. ⏚ DENOTES SIGNAL (LOW LEVEL) GROUND.
5. ▽ DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
6. ——— — — ——— DENOTES ASSEMBLY.
7. ——— DENOTES MAIN SIGNAL PATH.
8. — — — — DENOTES FEEDBACK PATH.
9. ▭ DENOTES REAR PANEL MARKING.
10. ▬ DENOTES SCREWDRIVER ADJUST.
11. ▭ DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
12. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY.
13. ALL RELAYS ARE SHOWN DEENERGIZED.



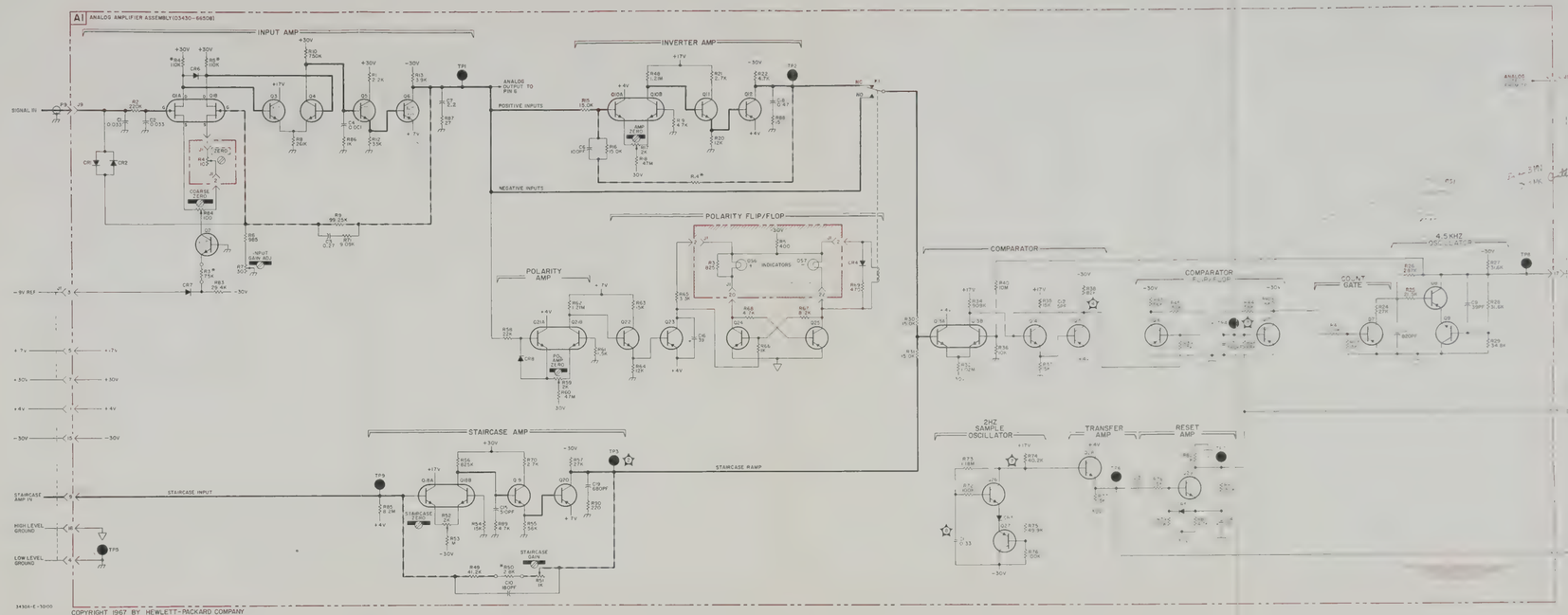


Figure 7-3A. Schematic Diagram, A1 Amplifier Assembly

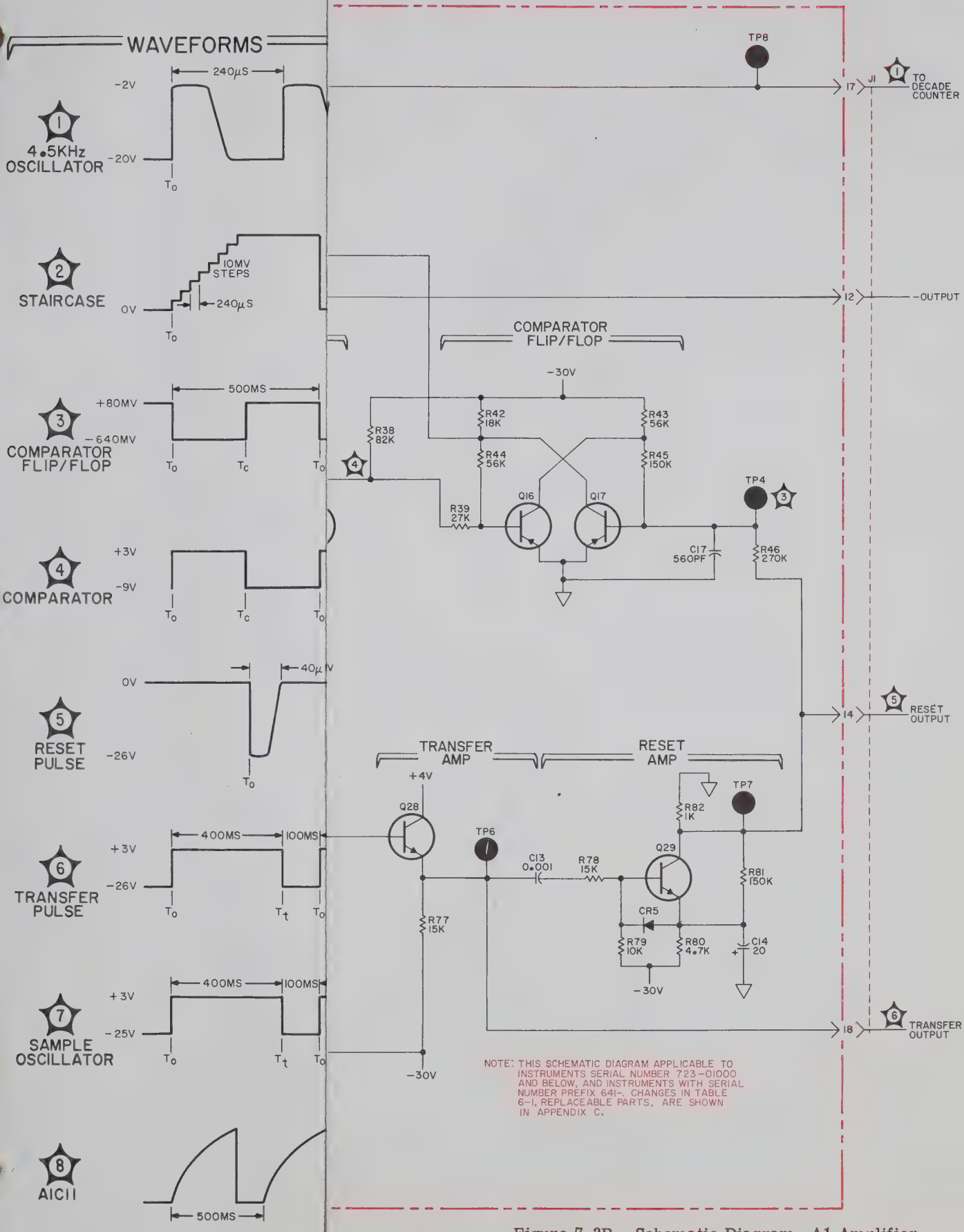


Figure 7-3B. Schematic Diagram, A1 Amplifier Assembly

WAVEFORMS

1. 4.5KHz OSCILLATOR — 240µS, -2V, -25V, T_0
2. STAIRCASE — 10MV STEPS, 0V, 240µS, T_0
3. COMPARATOR FLIP/FLOP — +60MV, -640MV, 500MS, T_0, T_c, T_0
4. COMPARATOR — +3V, -9V, T_0, T_c, T_0
5. RESET PULSE — 0V, -26V, 40µS, T_0
6. TRANSFER PULSE — +3V, -26V, 400MS, 100MS, T_0, T_t, T_0
7. SAMPLE OSCILLATOR — -3., -25V, 400MS, 100MS, T_0, T_t, T_0
8. AIC11 — 500MS

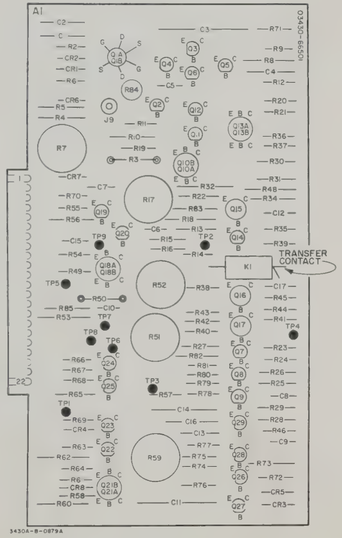
34354-8-07834

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ☆ DENOTES WAVESHAPE. SEE WAVESHAPE DRAWING.
4. ⏚ DENOTES SIGNAL (LOW LEVEL) GROUND.
5. ▽ DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
6. ——— DENOTES ASSEMBLY.
7. ═══ DENOTES MAIN SIGNAL PATH.
8. ═══ DENOTES FEEDBACK PATH.
9. ┌ ┐ DENOTES REAR PANEL MARKING.
10. ⊘ DENOTES SCREWDRIVER ADJUST.
11. ┌ ┐ DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
12. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY.
13. ALL RELAYS ARE SHOWN DEENERGIZED.



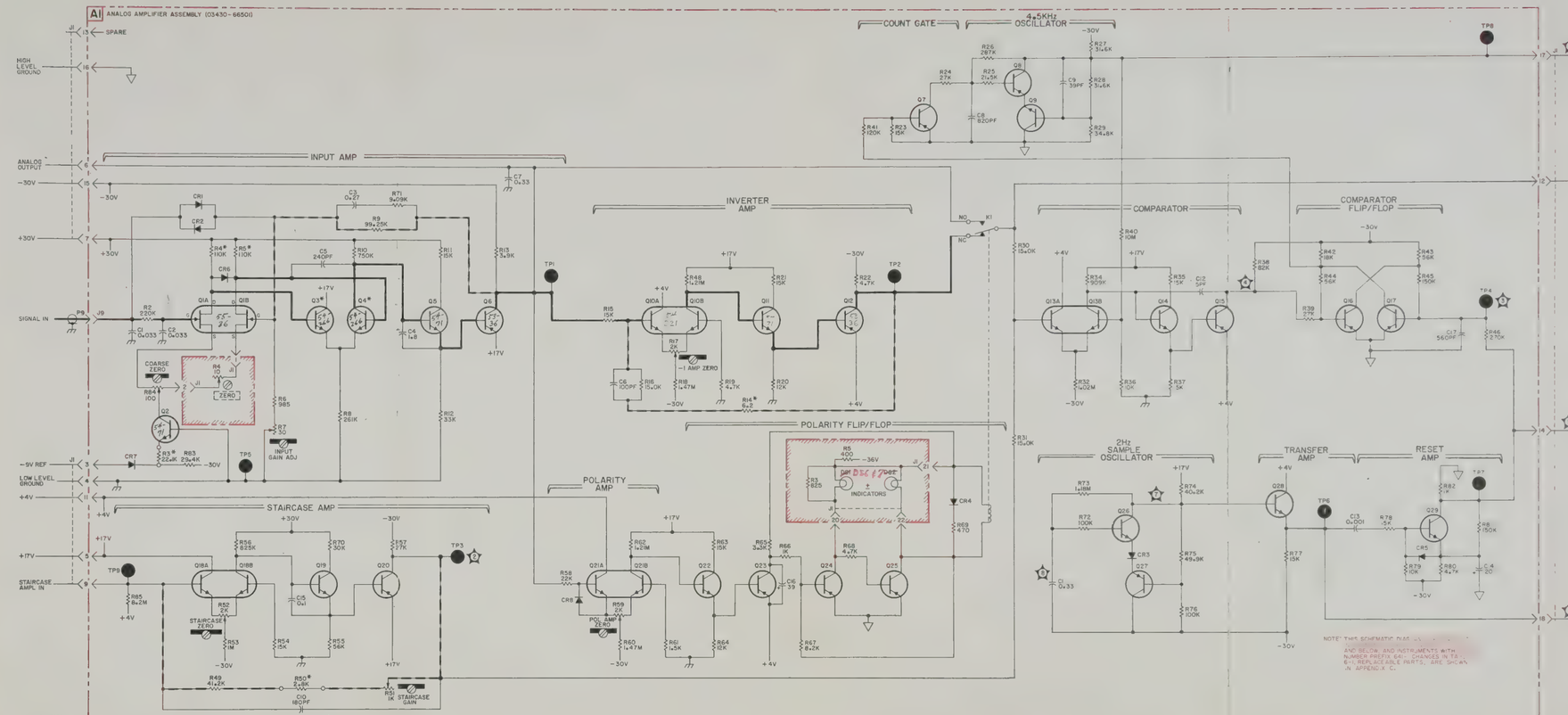
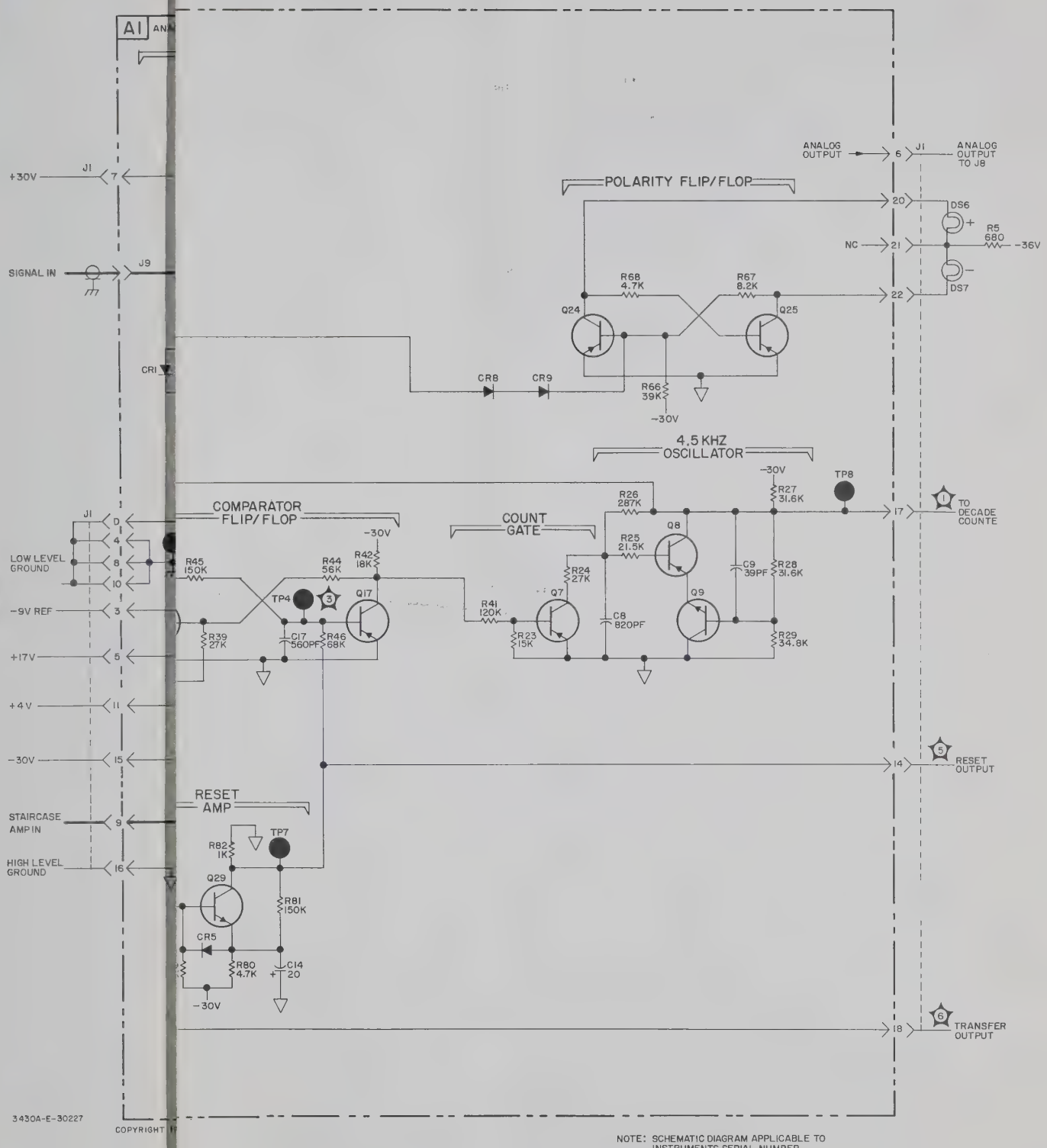
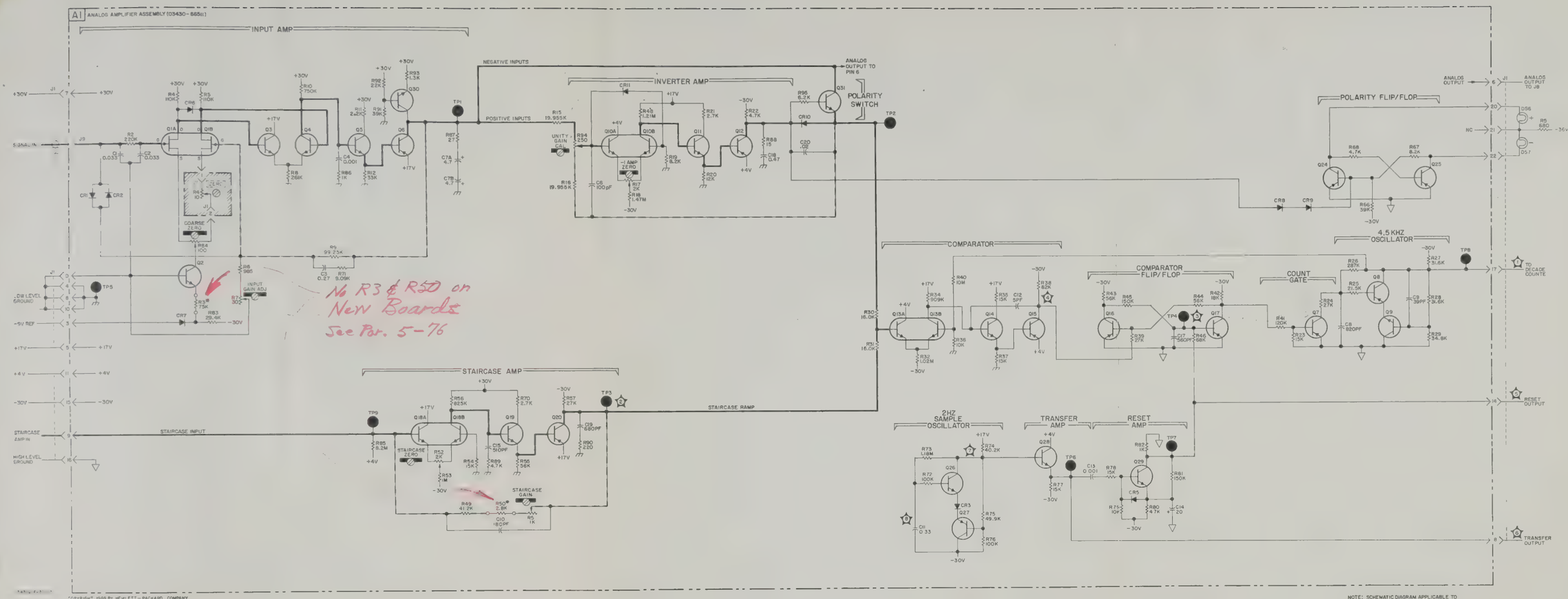


Figure 7-3B. Schematic Diagram, A1 Amplifier Assembly



NOTE: SCHEMATIC DIAGRAM APPLICABLE TO INSTRUMENTS SERIAL NUMBER 933-02551 AND ABOVE.


A1 ANALOG AMPLIFIER ASSEMBLY (03430-66511)
INPUT AMP
INVERTER AMP
POLARITY SWITCH
POLARITY FLIP/FLOP
COMPARATOR
COMPARATOR FLIP/FLOP
4.5 KHZ OSCILLATOR
COUNT GATE
STAIRCASE AMP
2HZ SAMPLE OSCILLATOR
TRANSFER AMP
RESET AMP
NEGATIVE INPUTS
POSITIVE INPUTS
ANALOG OUTPUT TO PIN 6
STAIRCASE RAMP
STAIRCASE INPUT
No R3 & R50 on New Boards See Par. 5-76
NOTE: SCHEMATIC DIAGRAM APPLICABLE TO INSTRUMENTS SERIAL NUMBER 933-02551 AND ABOVE.
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SERVICE NOTE

SUPERSEDES
NONE

-hp- MODEL 3430A DIGITAL VOLTMETER

Serial Number 749-02550 and below

REPLACEMENT OF A1 AMPLIFIER BOARD

The A1 Amplifier Board in the 3430A has been improved. The new board, -hp- Part No. 03430-66511, replaces the 03430-66508 and 03430-66501 boards used formerly. Circuit modifications on the new board include: K1 replaced by a transistor Polarity Switch; Polarity Flip/Flop circuit simplified; and improvements made in the Inverter Amplifier.

To install the 03430-66511 board in instruments with Serial Numbers 749-02550 and below, an instrument modification is required. Instruments above Serial Number 749-02550 require no modification.

PARTS REQUIRED FOR MODIFICATION (PRI).

Quantity	Description	-hp- Part No.
1	Connector	0362-0192
1 inch	Tubing, heat-shrinkable	0890-0041
1	Resistor, 680 Ω 2 W	0698-3635

MODIFICATION PROCEDURE (SERIAL NUMBER 749-02550 AND BELOW).

a. Replace R5 (400 Ω) with a 680 Ω 2 W resistor (-hp- Part No. 0698-3635). R5 is located on the chassis near the A1 board connector.

b. Remove R3 (825 Ω). R3 is located on the terminals behind the polarity annunciator.

c. Disconnect the Signal Input Cable from the old amplifier board.

d. Unsolder and discard the pin connector on the end of the signal input cable.

e. Strip the cable end so that approximately 3/8 inch of conductor is exposed.

f. Place a female connector (-hp- Part No. 0362-0192) on the cable end. Crip and solder the connector to the cable conductor.

g. Prepare a cable strain relief by bending the cable back against the connector body and placing a 1/2 inch length of heat-shrink tubing over the cable end of the connector. Carefully apply heat to the heat-shrink tubing. The modified cable connector is shown in Figure 1.

h. Install the 03430-66511 amplifier board in the 3430A. Connect the input signal cable to J9 on the amplifier board.

i. Perform a complete adjustment and calibration on the instrument. Note the new Polarity and Amplifier Adjustment procedure given on the next page.

Figure 1. Signal Input Cable.

JBA/my/WO

10/69-9

Operating and Service Manual Changes
(-hp- Part No. 03430-90001, dated October 1967)

ADJUSTMENT PROCEDURE

Replace the POLARITY AND INVERTER AMPLIFIER ADJUSTMENTS procedure with the following:

a. Connect a dc standard to the 3430A INPUT terminals. Set the dc standard output to + 0.005 V; set 3430A RANGE to 100 mV.

b. Using a dc differential voltmeter, measure and note the voltage at A1TP1: _____V. (Voltage should measure approximately + 0.5 V.).

c. Connect differential voltmeter to A1TP2. Adjust A1R17 (- 1 AMP ZERO) to set voltage at A1TP2 equal in value but of opposite polarity to voltage noted in Step b.

d. Change the dc standard output to - 0.0999 V. Measure and note the voltage at A1TP2: _____V. (Voltage should measure approximately - 9.99 V.)

e. Change the dc standard output to + 0.0999 V. Adjust A1R94 (UNITY GAIN CAL) to set the voltage at A1TP2 to within ± 2 mV of the voltage noted in Step d.

REPLACEABLE PARTS

Page 6-12: Delete R3.
Change R5 to 680 Ω, 2 W, -hp- Part No. 0698-3635.

Pages 6-4, 5, 6: Substitute the attached A1 Replaceable Parts List.

CIRCUIT DIAGRAMS

Replace Figure 7-3 with the attached schematic and component location diagram.

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	**03430-66511**	**1**	**Assembly: Amplifier** Used in serial number 933-02551 and higher	**-hp-**	
	03430-66508		Assembly: Amplifier Used in serial number 723-00801 to 749-02550	-hp-	
	03430-66501		Assembly: Amplifier Used in serial number 641-00700 and below	-hp-	
C1, C2	0160-0163	2	C: fxd 0.033 microfarads 10%	56289	192P33392
C3	0160-2137	1	C: fxd my 0.27 microfarads 10% 100 vdcw	56289	148P27491
C4	0160-0938	1	C: fxd mica 1000 pF 5%	04062	RDM15E102J1C
C5			Not assigned in serial number 723-01001 and higher		
	0140-0199		C: fxd mica 240 pF 5%	72136	RDM15F241J3C
C6	0140-0176	2	C: fxd mica 100 pF 2%	04062	RDM15F101G3C
C7			Not assigned in serial number 933-02551 and higher		
	0160-0128		C: fxd cer 2.2 microfarads 20% 25 vdcw Used in serial number 723-00801 to 749-02550	56289	5C15C2
	0160-0137		C: fxd cer 0.33 microfarads 20% 25 vdcw Used in serial number 641-00700 and below	56289	5C10A75-CML
C7A, C7B	0180-0100	2	C: fxd Ta elec 4.7 microfarads 10% 35 vdcw Added at serial number 933-02551	56289	150D475X9035B2-DYS
C8	0160-2009	1	C: fxd mica 820 pF 20%	04062	RDM15F821J3C
C9	0140-0190	1	C: fxd mica 39 pF 5%	04062	RDM15E390J3C
C10	0140-0197	1	C: fxd mica 180 pF	04062	RDM15F181J3C
C11	0170-0042	1	C: fxd my 0.33 microfarads 5% 100 vdcw	99515	obd
C12	0140-0209	1	C: fxd mica 5 pF 10% 100 vdcw	04062	RDM15C050K5C
C13	0140-0179	1	C: fxd mica 1000 pF 2%	04062	RDM19F102G3C
C14	0180-0049	1	C: fxd Al elect 20 microfarads + 75% - 10% 50 vdcw	56289	30D206G050CC2DSM
C15	0160-0362	4	C: fxd mica 510 pF 5% Used in serial number 723-01001 and higher	04062	RDM15F11J3C
C16			Not assigned in serial number 933-02551 and higher		
	0180-0393		C: fxd cer 39 microfarads 10% 10 vdcw Used in serial number 749-02550 and below	56289	30D107G003CB4
C17	0160-2212	1	C: fxd mica 560 pF 5%	04062	RDM19F561J3C
C18	0160-0174	1	C: fxd cer 0.47 microfarads + 80% - 20% 25 vdcw	56289	5C11B7
C19	0140-0208	1	C: fxd mica 680 pF 5%	04062	RDM19F561J3C
C20	0160-2605	1	C: fxd cer 0.22 microfarads - 10% + 80% 25 vdcw Added at serial number 933-02551	72982	5835Y5U203Z
CR1, CR2	1901-0156	4	Diode: Si 50 mA at + 1 V	01281	PS5553
CR3	1901-0025	46	Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR4			Not assigned in serial number 933-02551 and higher		
	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF Used in serial number 749-02550 and below	93332	D3072
CR5 thru CR11	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
J1 thru J8			Not assigned		
J9	0360-1514		Connector Used in serial number 933-02551 and higher		
	1251-0131		Connector: miniature female Used in serial number 749-02550 and below	00373	69026-1164(Red)
K1			Not assigned in serial number 933-02551 and higher		
	0490-0703		Relay: reed Used in serial number 749-02550 and below	-hp-	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)						
Q1A, B	1855-0036	2	TSTR: FET dual	15818	SU2119	
Q2	1854-0071	20	TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q3, Q4	1854-0266	4	TSTR: NPN 2N3711	01295	obd	
Q5	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q6	1853-0012	3	TSTR: Si PNP 2N2904A	04713	2N2904A	
Q7, Q8	1853-0036	10	TSTR: Si PNP 2N3906	04713	SPS-3612	
Q9	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q10A, B	1854-0221	3	TSTR: Si NPN 2N4045 dual	22229	BD-1148	
Q11	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q12	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612	
Q13A, B	1854-0221		TSTR: Si NPN 2N4045 dual	22229	BD-1148	
Q14	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q15	1853-0016	10	TSTR: Si PNP 2N3638	07263	2N3638	
Q16, Q17	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612	
Q18A, B	1854-0221		TSTR: Si NPN 2N4045 dual	22229	BD-1148	
Q19	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014	
Q20	1853-0069	1	TSTR: Si PNP 2N4122	07263	2N4122	
Q21A, B			Not assigned in serial number 933-02551 and higher			
	1854-0221		TSTR: Si NPN 2N4045 dual Used in serial number 749-02551 and below	22229	BD-1148	
Q22			Not assigned in serial number 933-02551 and higher			
	1854-0071		TSTR: Si NPN 2N3391 Used in serial number 749-02550 and below	24446	4JX16A1014	
Q23			Not assigned in serial number 933-02551 and higher			
	1853-0036		TSTR: Si PNP 2N3906 Used in serial number 749-02550 and below	04713	SPS-3612	
Q24, Q25	1853-0023	2	TSTR: Si PNP 2N3703	01295	obd	
Q26	1854-0087	4	TSTR: Si NPN 2N3417	04713	MPS3417	
Q27	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612	
Q28, Q29	1854-0087		TSTR: Si NPN 2N3417	04713	MPS3417	
Q30	1854-0039	1	TSTR: Si NPN 2N3053 Added at serial number 933-02551		2N3053	
Q31	1854-0087		TSTR: Si NPN 2N3417 Added at serial number 933-02551	04713	MPS3417	
R1			Not assigned			
R2	0684-2241	3	R: fxd comp 220 kilohms 10% 1/4 W	01121	CB2241	
R3*			See Paragraph 5-76			
R4, R5	0757-0776	2	R: fxd 110 kilohms 1% 1/4 W	19701	MF6C T-O	obd
R6	0811-1789	1	R: fxd prec ww 985 ohms 0.1% 1/40 W	05347	102A	obd
R7	2100-1560	2	R: var ww 30 ohms 10% 1-1/2 W	11236	110	obd
R8	0757-0064	1	R: fxd met flm 261 kilohms 1% 1/2 W	75042	CEC T-O	obd
R9	0811-1794	2	R: fxd prec ww 99.25 kilohms 0.1% 1/40 W	05347	102A	obd
R10	0757-0145	1	R: fxd met flm 750 kilohms 1% 1/4 W	75042	obd	
R11	0683-2225	1	R: fxd 2200 ohms 5% 1/4 W	01121	CB2225	
R12	0684-3331	3	R: fxd comp 33 kilohms 10% 1/4 W	01121	CB3331	
R13			Not assigned in serial number 933-02551 and higher			
	0686-3925		R: fxd 3900 ohms 5% 1/2 W Used in serial number 749-02550 and below	01121	EB3925	
R14*			See Paragraph 5-74			
R15, R16	0811-2411	4	R: fxd ww 16 kilohms 0.05% 1/20 W Used in serial number 943-02851 and higher	07088	KP110	obd
	0811-2397		R: fxd ww 19,955 ohms 0.25% 1/10 W Used in serial number 933-02551 to 933-02850	07088	KP110	obd
	03430-82601		R: fxd 15 kilohms 1% matched set of two Used in serial number 749-02550 and below	-hp-		
R17	2100-0282	2	R: var ww 2000 ohms 20% 1-1/2 W	71450	110	obd
R18	0698-3464	1	R: fxd met flm 1.47 megohms 1% 1/2 W	75042	CEC T-O	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)						
R19	0684-8221		R: fxd comp 8200 ohms 10% 1/4 W Used in serial number 933-02551 and higher	01121	CB8221	
	0684-4721		R: fxd 4700 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB4721	
R20	0684-1231	2	R: fxd comp 12 kilohms 10% 1/4 W	01121	CB1231	
R21	0683-2725	2	R: fxd 2.7 kilohms 5% 1/4 W	01121	CB2725	
R22	0686-4725	2	R: fxd 4700 ohms 5% 1/2 W	01121	EB4725	
R23	0684-1531	6	R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R24	0684-2731	3	R: fxd comp 27 kilohms 10% 1/4 W	01121	CB2731	
R25	0757-0199	1	R: fxd met flm 21.5 kilohms 1% 1/8 W	000LM	obd	
R26	0698-3456	1	R: fxd met flm 287 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R27, R28	0698-3160	3	R: fxd met flm 31.6 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R29	0757-0123	1	R: fxd 34.8 kilohms 1% 1/8 W	75042	CEA T-O	obd
R30, R31	0811-2411		R: fxd ww 16 kilohms 0.05% 1/20 W Used in serial number 933-02551 and higher	07088	KP110	obd
	03430-82601		R: fxd 15 kilohms 1% matched set of two Used in serial number 749-02550 and below	-hp-		
R32	0698-4074	1	R: fxd met flm 1.02 megohms 1% 1/2 W	75042	CEC T-O	obd
R33			Not assigned			
R34	0757-0350	1	R: fxd met flm 909 kilohms 1% 1/4 W	75042	obd	
R35	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R36	0684-1031	3	R: fxd 10 kilohms 10% 1/4 W	01121	CB1031	
R37	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R38	0684-8231	1	R: fxd comp 82 kilohms 10% 1/4 W	01121	CB8231	
R39	0684-2731		R: fxd 27 kilohms 10% 1/4 W	01121	CB2731	
R40	0684-1061	1	R: fxd comp 10 megohms 10% 1/4 W	01121	CB1061	
R41	0684-1241	1	R: fxd 120 kilohms 10% 1/4 W	01121	CB1241	
R42	0684-1831	1	R: fxd 18 kilohms 10% 1/4 W	01121	CB1831	
R43, R44	0684-5631	5	R: fxd 56 kilohms 10% 1/4 W	01121	CB5631	
R45	0684-1541	2	R: fxd 150 kilohms 10% 1/4 W	01121	CB1541	
R46	0684-6831	5	R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831	
R47			Not assigned			
R48	0757-0871	1	R: fxd met flm 1.21 megohms 1% 1/2 W	91637	MFF 1/2 T-O	
R49	0698-5166	1	R: fxd ww 41.2 kilohms 1% 1/8 W	75042	CEA T-9	
R50*			See Paragraph 5-77			
R51	2100-2069	1	R: var comp 1000 ohms 20% 1/2 W	71450	RV5LAYSB255B	
R52	2100-0282		R: var ww 2000 ohms 20% 1-1/2 W	71450	110	obd
R53	0757-0017	1	R: fxd 1 megohm .5% 1/2 W	75042	CEC T-2	
R54	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R55	0684-5631		R: fxd 56 kilohms 10% 1/4 W	01121	CB5631	
R56	0757-0793	1	R: fxd met flm 825 kilohms 1% 1/4 W	19701	MF6C T-O	obd
R57	0684-2731		R: fxd 27 kilohms 10% 1/4 W	01121	CB2731	
R58			Not assigned in serial number 933-02551 and higher			
	0684-2231		R: fxd 22 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB2231	
R59			Not assigned in serial number 933-02551 and higher			
	2100-0282		R: var ww 2000 ohms 20% 1-1/2 W Used in serial number 749-02550 and below	71450	110	obd
R60			Not assigned in serial number 933-02551 and higher			
	0698-3464		R: fxd met flm 1.47 megohms 10% 1/2 W Used in serial number 749-02550 and below	75042	CEC T-O	obd
R61			Not assigned in serial number 933-02551 and higher			
	0684-1521		R: fxd comp 1500 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1521	
R62			Not assigned in serial number 933-02551 and higher			
	0757-0871		R: fxd met flm 1.21 megohms 1% 1/2 W Used in serial number 749-02550 and below	91637	MFF 1/2 T-O	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)						
R63			Not assigned in serial number 933-02551 and higher			
	0684-1531		R: fxd 15 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1531	
R64			Not assigned in serial number 933-02551 and higher			
	0684-1231		R: fxd comp 12 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1231	
R65			Not assigned in serial number 933-02551 and higher			
	0686-3325		R: fxd 3300 ohms 5% 1/2 W Used in serial number 749-02550 and below	01121	EB3325	
R66	0684-3931		R: fxd comp 39 kilohms 10% 1/4 W Used in serial number 933-02551 and higher	01121	CB3931	
	0684-1021		R: fxd 1000 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1021	
R67	0684-8221	1	R: fxd 8200 ohms 10% 1/4 W	01121	CB8221	
R68	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721	
R69			Not assigned in serial number 933-02551 and higher			
	0684-4711		R: fxd 470 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB4711	
R70	0683-2725	1	R: fxd comp 2700 ohms 5% 1/4 W	01121	CB2725	
R71	0757-0288	1	R: fxd met flm 9090 ohms 1% 1/8 W	000LM	obd	
R72	0757-0465	2	R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R73	0698-4989	1	R: fxd met flm 1.18 megohms 1% 1/2 W	19701	MF5C T-O	obd
R74	0698-3499	1	R: fxd met flm 40.2 kilohms 1% 1/8 W	75042	CEA T-O	obd
R75	0698-3228	1	R: fxd met flm 49.9 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R76	0757-0465		R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R77, R78	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R79	0684-1031		R: fxd 10 kilohms 10% 1/4 W	01121	CB1031	
R80	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721	
R81	0684-1541		R: fxd 150 kilohms 10% 1/4 W	01121	CB1541	
R82	0687-1021	1	R: fxd 1000 ohms 10% 1/2 W	01121	EB1021	
R83	0698-4490	1	R: fxd 29.4 kilohms 5% 1/4 W	91637	MFF-1/8 T-O	
R84	2100-0281	2	R: var ww single turn 100 ohms 20% 1.5 W	71450	110	obd
R85	0686-8255	1	R: fxd comp 8.2 megohms 5% 1/2 W	01121	EB8255	
R86	0683-1025	1	R: fxd comp 1000 ohms 5% 1/4 W	01121	CB1025	
R87	0683-2705	1	R: fxd comp 27 ohms 5% 1/4 W	01121	CB2705	
R88	0683-1505	1	R: fxd comp 15 ohms 5% 1/4 W	01121	CB1505	
R89	0683-4725	1	R: fxd comp 4700 ohms 5% 1/4 W	01121	CB4725	
R90	0683-2215	1	R: fxd comp 220 ohms 5% 1/4 W R85 thru R90 added at serial number 723-01001	01121	CB2215	
R91	0684-3931	1	R: fxd comp 39 kilohms 10% 1/4 W	01121	CB3931	
R92	0684-2231	1	R: fxd comp 22 kilohms 10% 1/4 W	01121	CB2231	
R93	0683-1325	1	R: fxd comp 1.3 kilohms 5% 1/4 W R91 thru R93 added at serial number 933-02551	01121	CB1325	
R94	2100-0326	1	R: var ww 75 ohms 20% 1.5 W Used in serial number 943-02851 and higher	71450	110	obd
	2100-0439		R: var ww 250 ohms 20% 1.5 W Used in serial number 933-02551 to 933-02850 Not assigned in serial number 749-02550 and below	71450	110	obd
R95	0683-6225	1	R: fxd comp 6.2 kilohms 5% 1/4 W Added at serial number 933-02551	01121	CB6225	

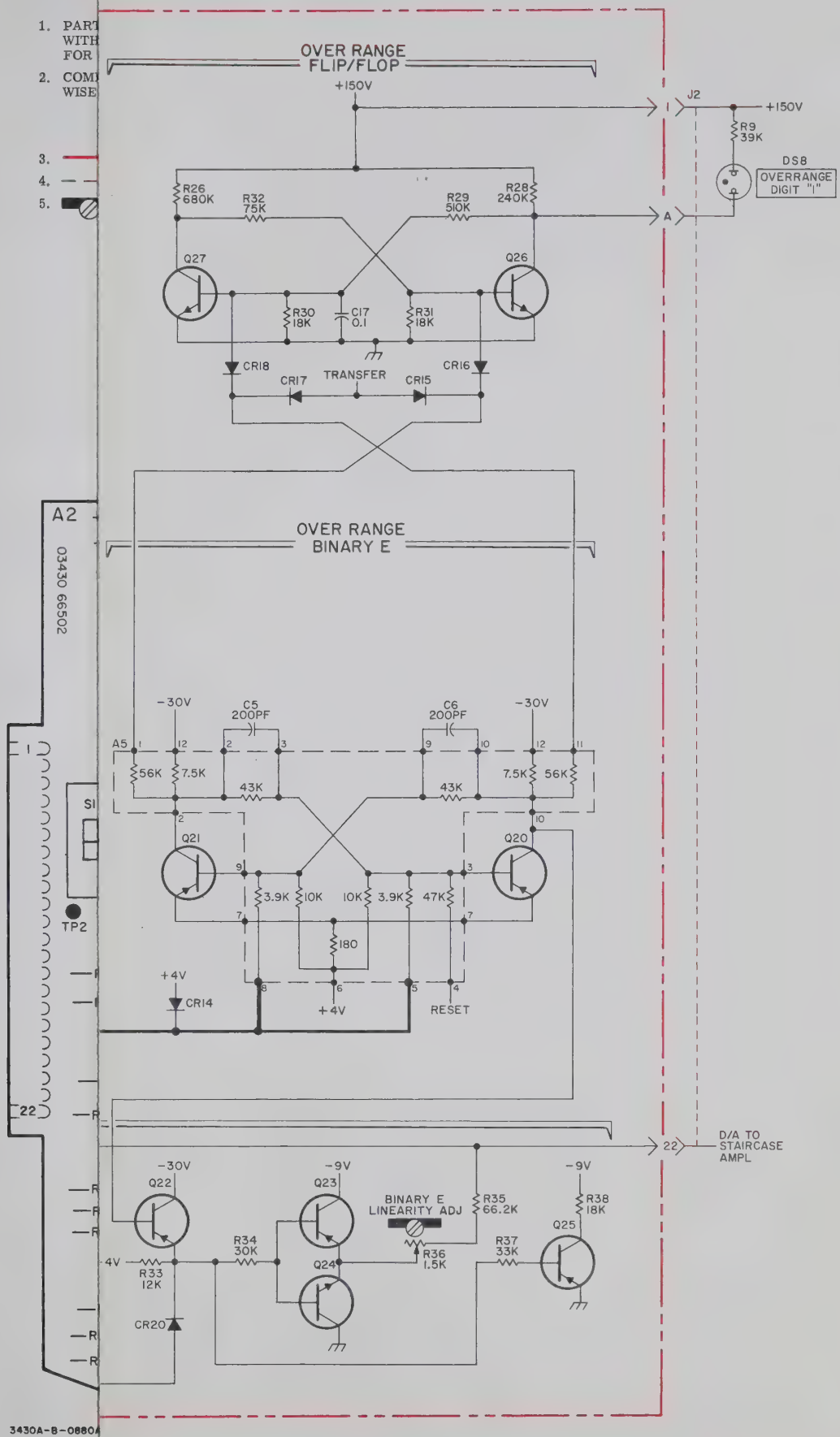


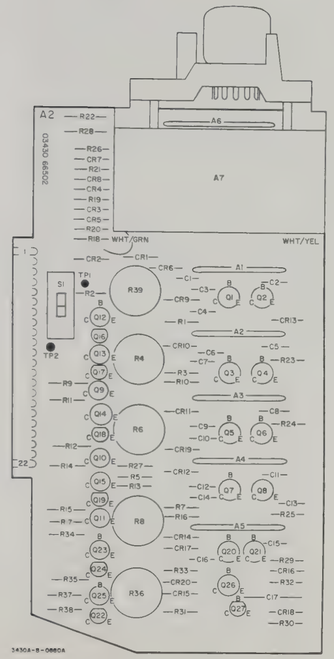
Figure 7-4. Schematic Diagram, A2 Hundreds Decade Counter and D/A

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)						
R63			Not assigned in serial number 933-02551 and higher			
	0684-1531		R: fxd 15 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1531	
R64			Not assigned in serial number 933-02551 and higher			
	0684-1231		R: fxd comp 12 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1231	
R65			Not assigned in serial number 933-02551 and higher			
	0686-3325		R: fxd 3300 ohms 5% 1/2 W Used in serial number 749-02550 and below	01121	EB3325	
R66	0684-3931		R: fxd comp 39 kilohms 10% 1/4 W Used in serial number 933-02551 and higher	01121	CB3931	
	0684-1021		R: fxd 1000 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1021	
R67	0684-8221	1	R: fxd 8200 ohms 10% 1/4 W	01121	CB8221	
R68	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721	
R69			Not assigned in serial number 933-02551 and higher			
	0684-4711		R: fxd 470 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB4711	
R70	0683-2725	1	R: fxd comp 2700 ohms 5% 1/4 W	01121	CB2725	
R71	0757-0288	1	R: fxd met flm 9090 ohms 1% 1/8 W	000LM	obd	
R72	0757-0465	2	R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R73	0698-4989	1	R: fxd met flm 1.18 megohms 1% 1/2 W	19701	MF5C T-O	obd
R74	0698-3499	1	R: fxd met flm 40.2 kilohms 1% 1/8 W	75042	CEA T-O	obd
R75	0698-3228	1	R: fxd met flm 49.9 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R76	0757-0465		R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R77, R78	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R79	0684-1031		R: fxd 10 kilohms 10% 1/4 W	01121	CB1031	
R80	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721	
R81	0684-1541		R: fxd 150 kilohms 10% 1/4 W	01121	CB1541	
R82	0687-1021	1	R: fxd 1000 ohms 10% 1/2 W	01121	EB1021	
R83	0698-4490	1	R: fxd 29.4 kilohms 5% 1/4 W	91637	MFF-1/8 T-O	
R84	2100-0281	2	R: var ww single turn 100 ohms 20% 1.5 W	71450	110	obd
R85	0686-8255	1	R: fxd comp 8.2 megohms 5% 1/2 W	01121	EB8255	
R86	0683-1025	1	R: fxd comp 1000 ohms 5% 1/4 W	01121	CB1025	
R87	0683-2705	1	R: fxd comp 27 ohms 5% 1/4 W	01121	CB2705	
R88	0683-1505	1	R: fxd comp 15 ohms 5% 1/4 W	01121	CB1505	
R89	0683-4725	1	R: fxd comp 4700 ohms 5% 1/4 W	01121	CB4725	
R90	0683-2215	1	R: fxd comp 220 ohms 5% 1/4 W R85 thru R90 added at serial number 723-01001	01121	CB2215	
R91	0684-3931	1	R: fxd comp 39 kilohms 10% 1/4 W	01121	CB3931	
R92	0684-2231	1	R: fxd comp 22 kilohms 10% 1/4 W	01121	CB2231	
R93	0683-1325	1	R: fxd comp 1.3 kilohms 5% 1/4 W R91 thru R93 added at serial number 933-02551	01121	CB1325	
R94	2100-0326	1	R: var ww 75 ohms 20% 1.5 W Used in serial number 943-02851 and higher	71450	110	obd
	2100-0439		R: var ww 250 ohms 20% 1.5 W Used in serial number 933-02551 to 933-02850 Not assigned in serial number 749-02550 and below	71450	110	obd
R95	0683-6225	1	R: fxd comp 6.2 kilohms 5% 1/4 W Added at serial number 933-02551	01121	CB6225	

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ——— — — ——— DENOTES ASSEMBLY.
4. — — — — — — — DENOTES SUBASSEMBLY.
5. ⊘ DENOTES SCREWDRIVER ADJUST.



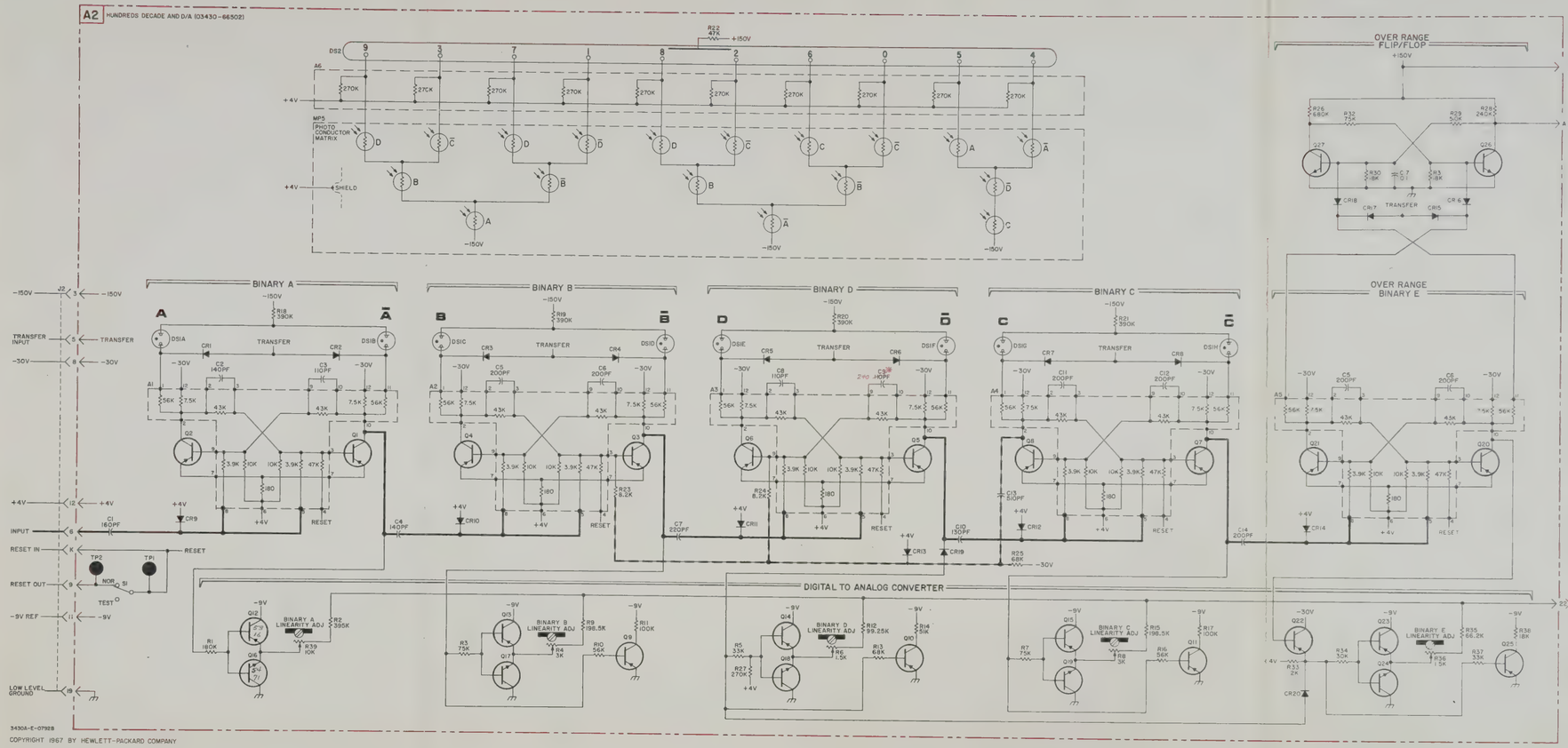


Figure 7-4. Schematic Diagram, A2 Hundreds Decade Counter and D/A

01804-1

7-9/7-10

1. PART
WITH
FOR C
2. COMP
WISE
3.
4.
5.

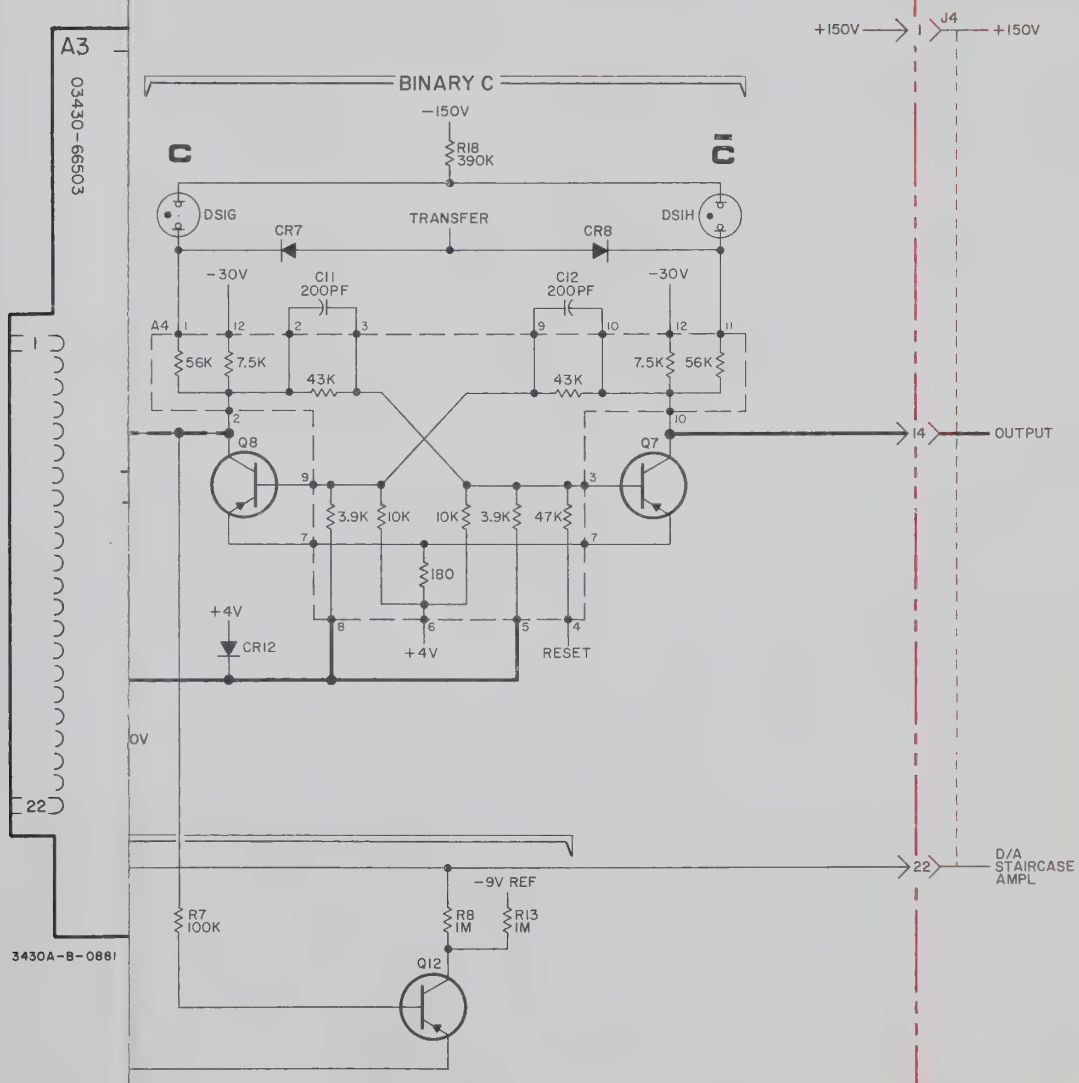
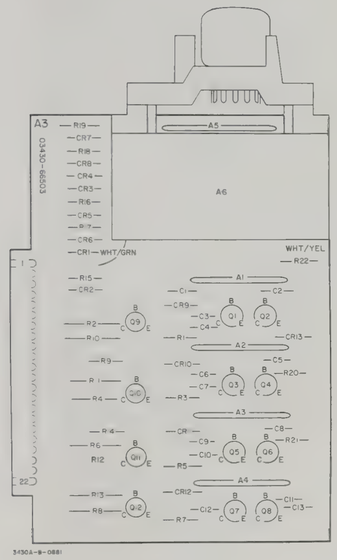


Figure 7-5. Schematic Diagram, A3 Tens Decade Counter and D/A

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ——— — — ——— DENOTES ASSEMBLY
4. — — — — — — DENOTES SUBASSEMBLY.
5. ⊘ DENOTES SCREWDRIVER ADJUST.



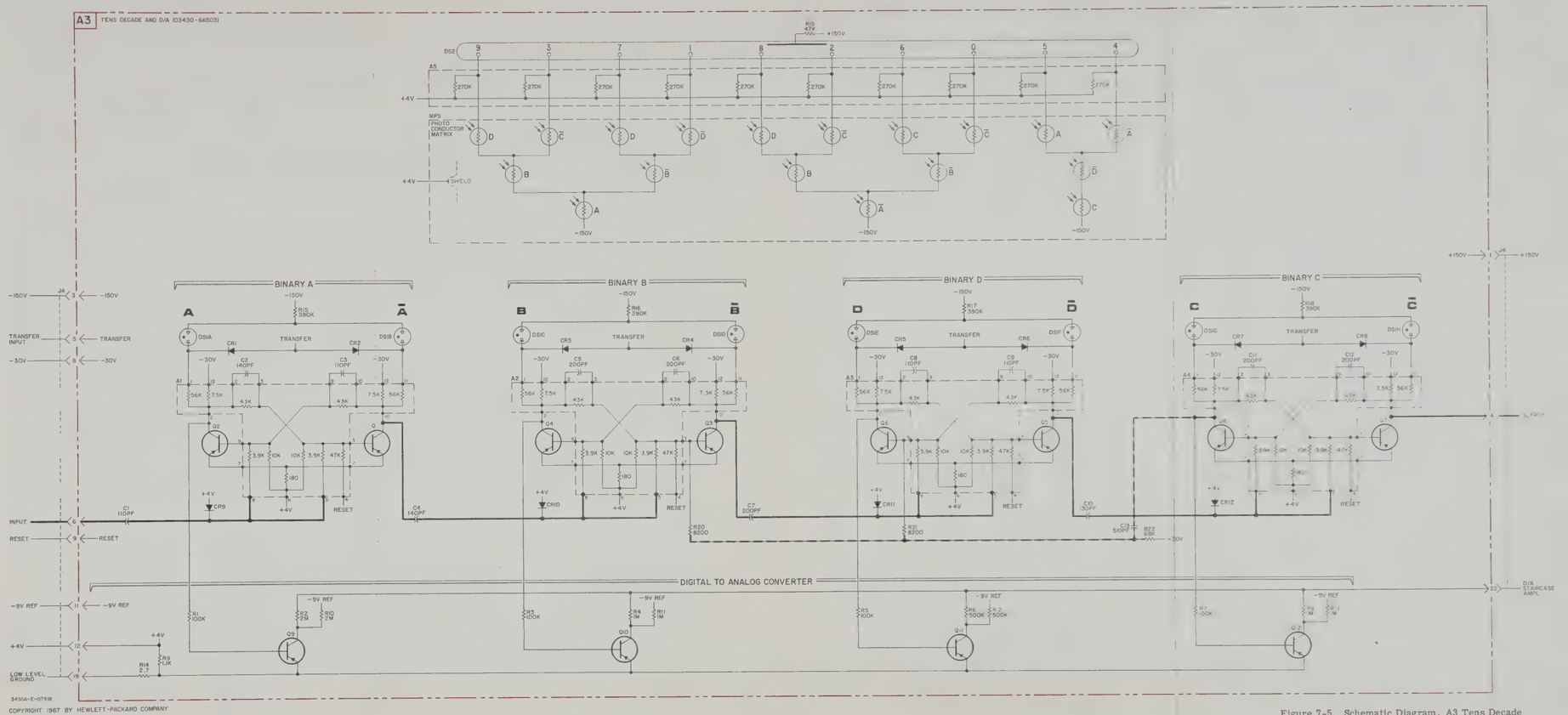


Figure 7-5. Schematic Diagram, A3 Tens Decade Counter and D/A

1. PART
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4.

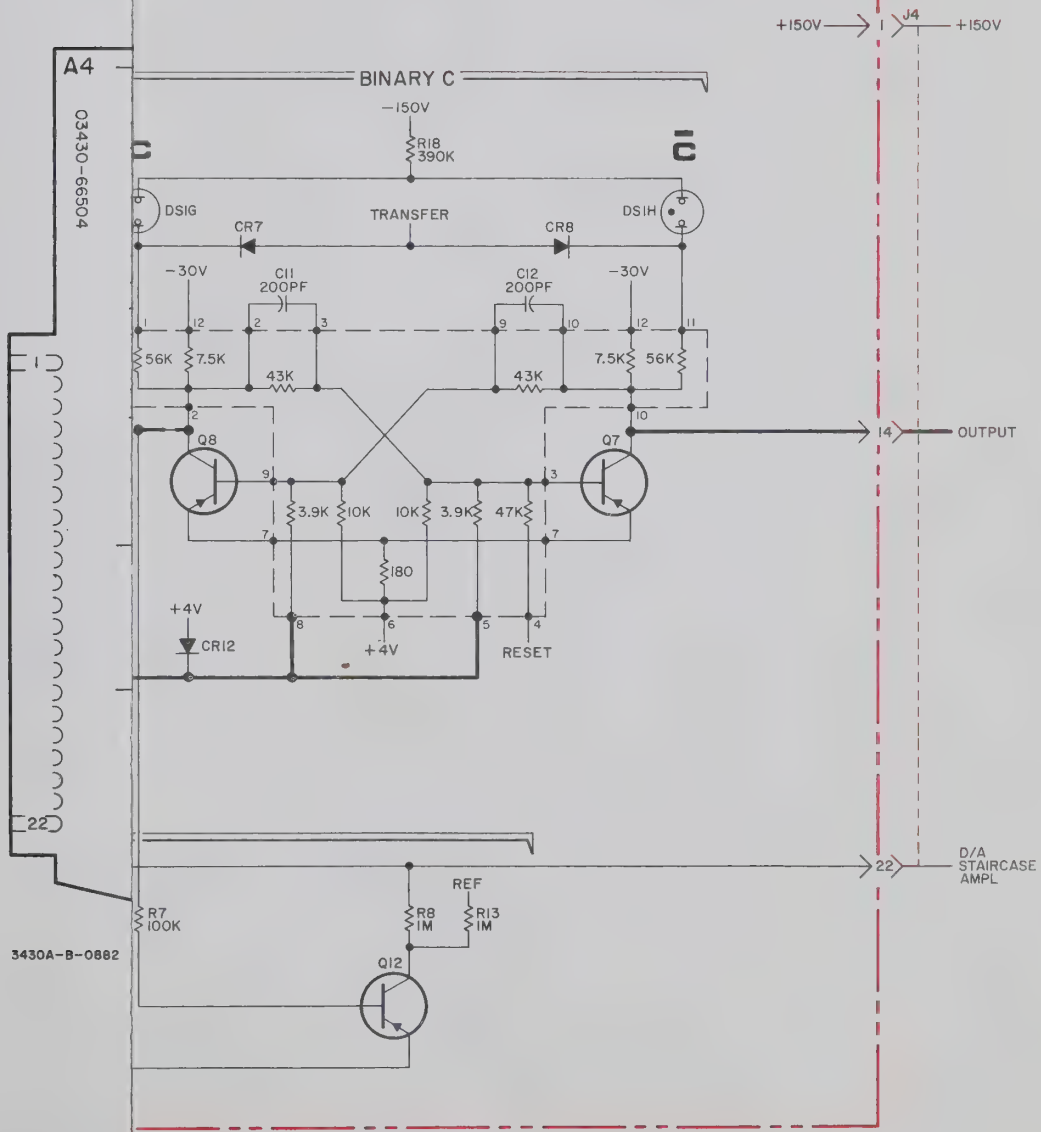
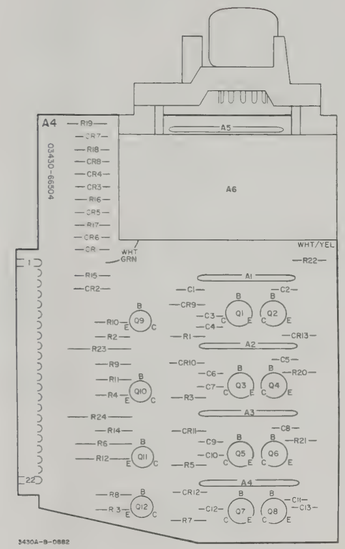


Figure 7-6. Schematic Diagram, A4 Units Decade Counter and D/A

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ——— DENOTES ASSEMBLY.
4. — — — — — — DENOTES SUBASSEMBLY.



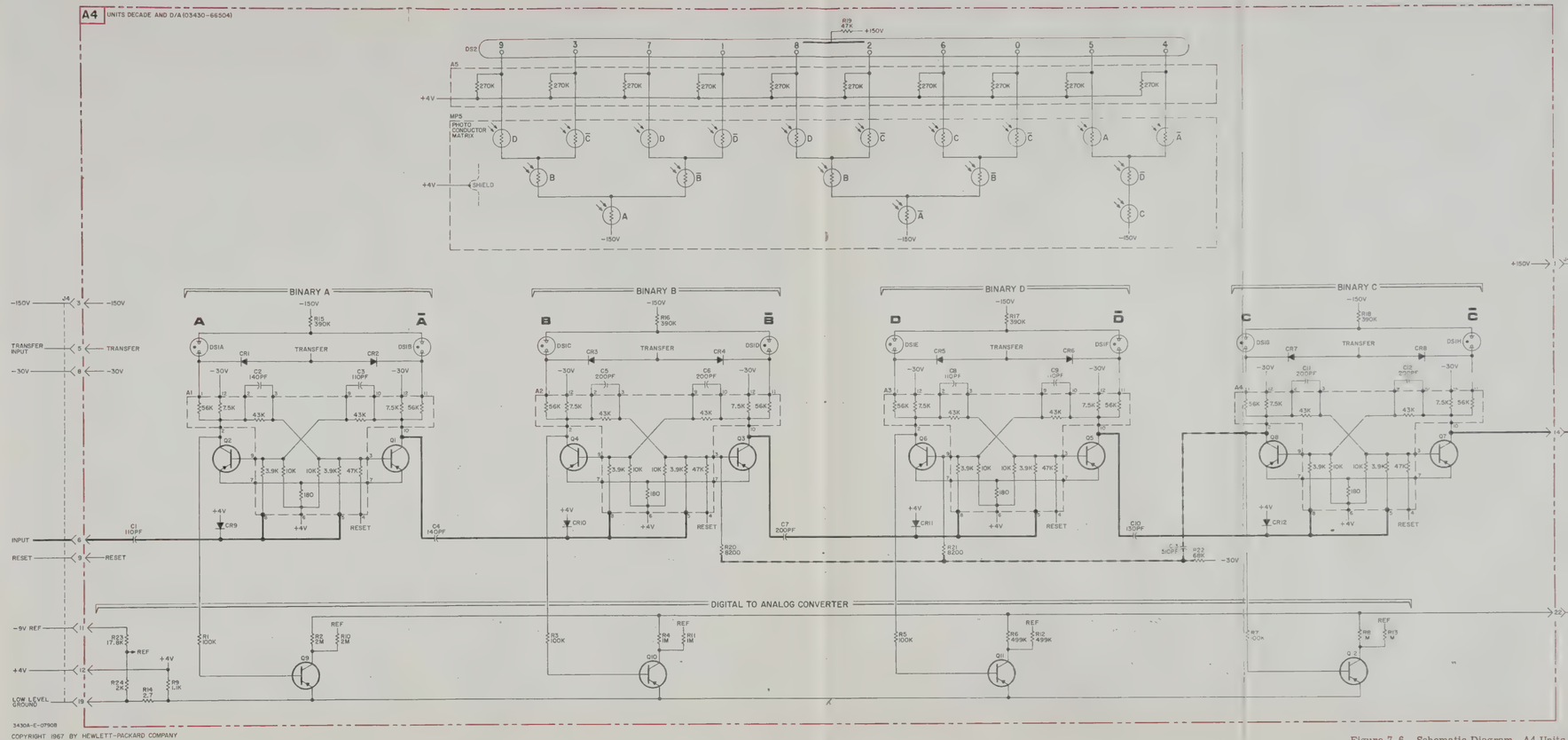


Figure 7-6. Schematic Diagram, A4 Units Decade Counter and D/A

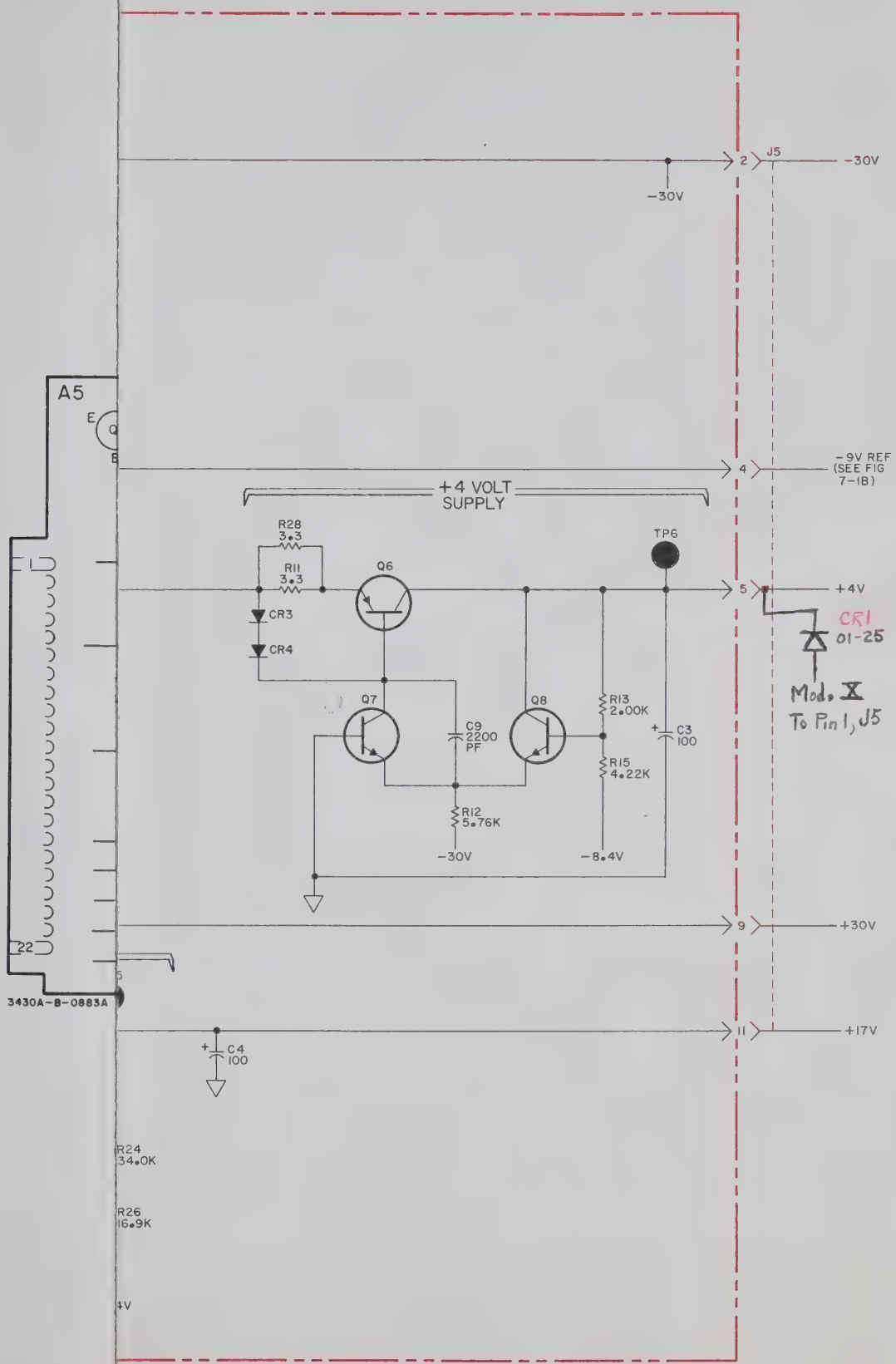
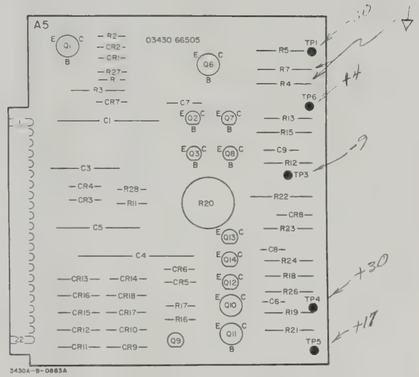


Figure 7-7. Schematic Diagram, A5 Power Supply Assembly



NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ⏚ DENOTES POWER LINE GROUND.
4. ⏚ DENOTES SIGNAL (LOW LEVEL) GROUND.
5. ▽ DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
6. ——— — — — DENOTES ASSEMBLY.
7. DENOTES SCREWDRIVER ADJUST.
8. DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.

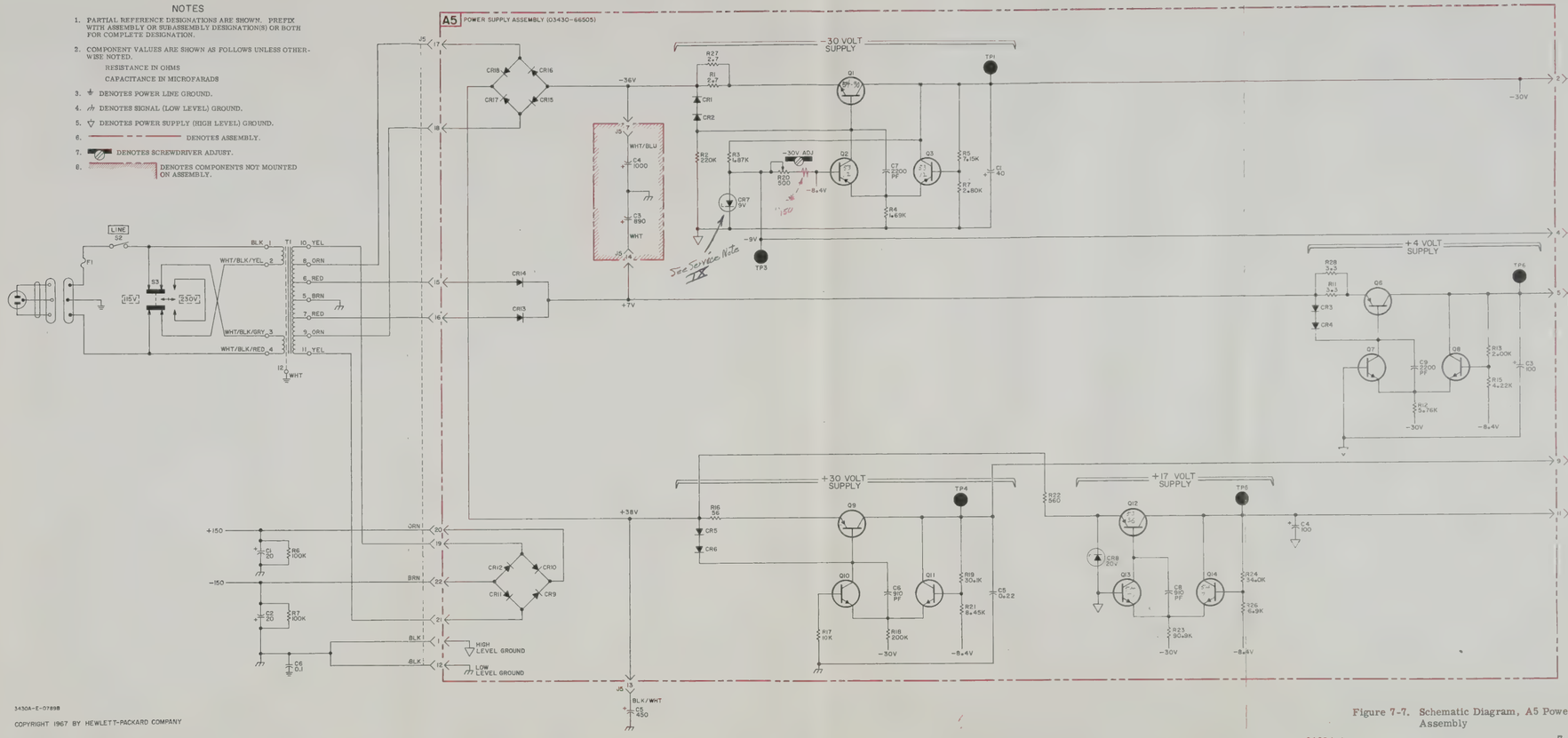


Figure 7-7. Schematic Diagram, A5 Power Supply Assembly

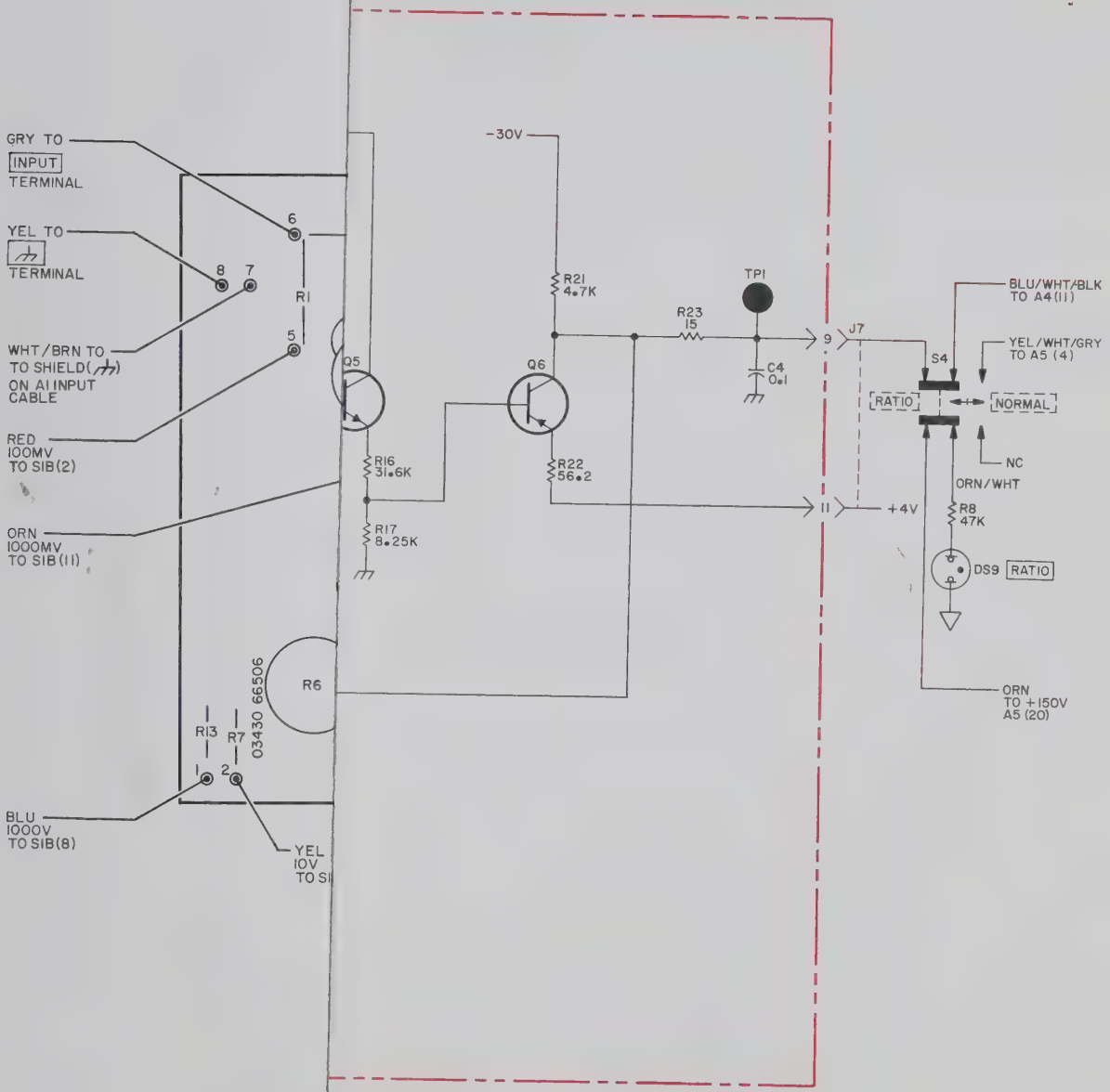
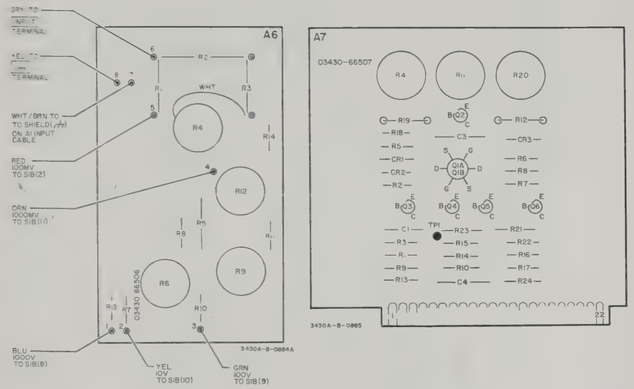


Figure 7-8. Schematic Diagram, A6 Attenuator and A7 Reference Amplifier (Option 01)

01804-1



NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ⏚ DENOTES SIGNAL (LOW LEVEL) GROUND.
4. ▽ DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
5. ——— – – – ——— DENOTES ASSEMBLY.
6. ▭ DENOTES FRONT PANEL MARKING.
7. ▭ DENOTES REAR PANEL MARKING.
8. ▬ DENOTES SCREWDRIVER ADJUST.
9. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY.

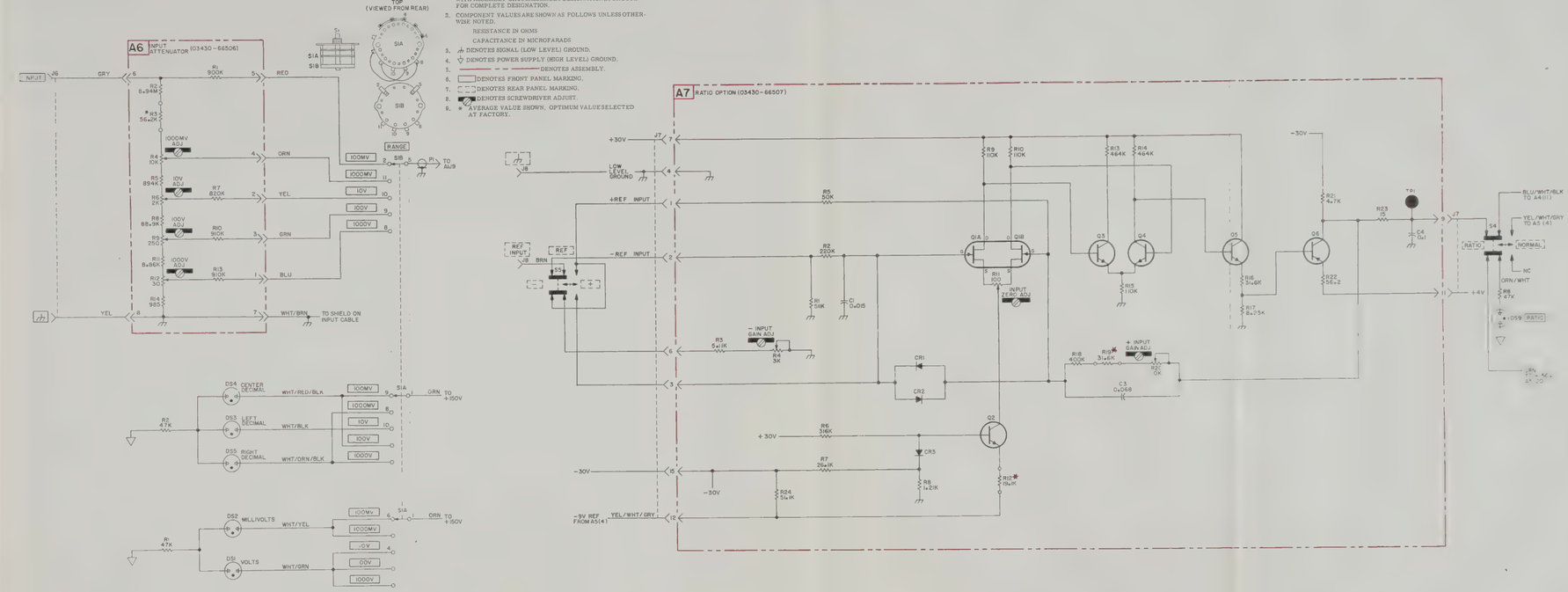


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Figure 7-8. Schematic Diagram, A6 Attenuator and A7 Reference Amplifier (Option 01)

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N. Y.
00334	Humidaire Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N. J.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04354	Precision Paper Tube Co.	Chicago, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04777	Automatic Electric Sales Corp.	Northlake, Ill.
04796	Sequoia Wire & Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P. M. Motor Company	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metropolitan Telecommunications Corp., Metro Cap. Division	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06475	Western Devices, Inc.	Inglewood, Calif.
06540	Amatom Electronic Hardware Co. Inc.	New Rochelle, N. Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06751	U. S. Semcor Division of Nuclear Corp. of America	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N. Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert, Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada.
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09664	The Bristol Co.	Waterbury, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N. J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hannover, Germany
13835	Midland Mfg. Co.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co. Inc.	Brooklyn, N.Y.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15909	The Daven Co.	Livingston, N.J.
16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
16352	Computer Diode Corp.	Lodi, N. J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
18486	Radio Industries	Des Plaines, Ill.
18583	Curtis Instrument Inc.	Mt. Kisco, N.Y.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Corp.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
63743	Ward Leonard Electric	Mt. Vernon, N.Y.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth 1, N.J.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70319	Allmetal Screw Prod. Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
71707	Coto Coil Co., Inc.	Providence, R.I.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72699	General Instrument Corp., Semiconductor Div.	Newark, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co, Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	So. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N. Y.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostran Instrument and Electronic Co.	South Pasadena, Calif.
77250	Phoell Mfg. Co.	Chicago, Ill.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association.	Any brand tube meeting EIA standards Washington, D.C.
80207	Unimax Switch, Div. of W.L. Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.

From: FSC. Handbook Supplements
H4-1 Dated DECEMBER 196
H4-2 Dated MARCH 1962

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

Code No.	Manufacturer	Address
81349	Military Specification	.....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Eveready Battery	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronis, Inc.	New York, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	Seattle, Wash.
87930	Tower Mfg. Corp	Providence, R. I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89462	Waldes Kohinoor, Inc.	Cambridge, Mass.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers', Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93788	Howard J. Smith Inc.	Port Monmouth, N. J.
93929	G. V. Controls	Livingston, N. J.
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94222	Southco Div. of S. Chester Corp.	Lester, Pa.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94330	Wire Cloth Products Inc.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95023	Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordas Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
97979	Reon Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98731	General Mills	Minneapolis, Minn.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

J0000	Winchester Electronics, Inc.	Santa Monica, Calif.
0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	England
000AC	Indiana General Corp., Elect. Div.	Indiana
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Manufacturing Co.	San Jose 27, Calif.
000QQ	Cooltron	Oakland, Calif.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000WW	California Eastern Lab.	Burlingame, Calif.
000YY	S.K. Smith Co.	Los Angeles 45, Calif.

From: FSC. Handbook Supplements
H4-1 Dated DECEMBER 1964
H4-2 Dated MARCH 1962

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TWX: 610-562-1952

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Guatemala City
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HP Instrument AB
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Telex: 2.24.86
Cable: HEWPACKSA Geneva

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AUSTRALIA
Sample Electronics (Vic) Pty., Ltd.
22-26 Weir Street
Glen Iris S.E. 6
Melbourne, Victoria
Tel: 20-1371 (4 lines)

Sample Electronics
(N.S.W.) Pty. Ltd.
4 Grose Street
Glebe, New South Wales
Tel: 69-6338

ETHIOPIA
African Salespower & Agency
Private Ltd., Co.
P. O. Box 718
Addis Ababa
Tel: 44090

INDIA
The Scientific Instrument Co., Ld
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Allahabad 1
Tel: 2451

The Scientific Instrument Co., Ld
240, Dr. Dadabhai Naoroji Road
Bombay 1
Tel: 26-2642

The Scientific Instr. Co., Ld.
11, Esplanade East
Calcutta 1
Tel: 23-4129

The Scientific Instrument Co., Ld.
30, Mount Road
Madras 2
Tel: 86339

The Scientific Instrument Co., Ld.
B-7, Ajmeri Gate Extn.
New Delhi 1
Tel: 27-1053

IRAN
Telecom, Ltd.
P. O. Box 1812
Teheran
Tel: 43850, 48111

ISRAEL
Electronics & Engineering
Division of Motorola Israel Ltd.
16, Kremenetski Street
Tel-Aviv
Tel: 35021/2/3

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Shinhankyu Building
No. 8, Umeda
Kita-ku, **Osaka** City
Tel: 313-0091

Yokogawa-Hewlett-Packard Ltd.
Ito Building
No. 59, Kotori-cho
Nakamura-ku, **Nagoya** City
Tel: 551-0215

Yokgawa-Hewlett-Packard Ltd.
Ohashi Building
No. 59, I-chome, Yoyogi
Shibuya-ku, **Tokyo**
Tel: 370-2281

KENYA
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P. O. Box 2754
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Hotel Ambassadeur
Nairobi
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KOREA
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112-35 Sokong-Dong
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Clemenceau Center
Beirut
Tel: 220846

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MANUAL BACKDATING CHANGES

MODEL 3430A

DC DIGITAL VOLTMETER

Manual Serial Prefixed: 641-
-hp- Part No. 03430-90000

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
723-01000 and below	1		
641-00175 and below	1, 2		

CHANGE 1

Section VI, Replaceable Parts (see Figure 7-3B).

Change A1C4 to C: fxd 1.8 μF ±10%	0180-0101
Add A1C5 C: fxd mica 240 pF ±5%	0140-0199
Change A1C7 to C: fxd 0.33 μF ±20%	0160-0137
Change A1C15 to C: fxd 0.1 μF + 80% -20%	0150-0121
Delete A1C18 C: fxd 0.47 μF	0160-0174
Delete A1C19 C: fxd 680 pF	0140-0208
Change A1Q6, 7, 8, 12, 16, 17, 20, 23 and 27 to TSTR: PNP 2N3906	1853-0036
Change A1R11 to R: fxd 15 kΩ ±10% 1/4 W	0684-1531
Change A1R21 to R: fxd 15 kΩ ±10% 1/4 W	0684-1531
Change A1R70 to R: fxd 30 kΩ ±5% 1/4 W	0683-3035
Delete A1R86 R: fxd 1000 Ω	0683-1025
Delete A1R87 R: fxd 27 Ω	0683-2705
Delete A1R88 R: fxd 15 Ω	0683-1505
Delete A1R89 R: fxd 4700 Ω	0683-4725
Delete A1R90 R: fxd 220 Ω	0683-2215

CHANGE 2

If A1R46 has not been changed to R: fxd 68 kΩ ±10% 1/4 W, 0684-6831, and A1R47 has not been replaced with A1C17, C: fxd mica 560 pF 0160-2212, this modification should be made so that comparator flip-flop conforms to schematic diagram Figure 7-3, and Table of Replaceable Parts, Section VI. This change improves stability of the Comparator Flip-Flop, eliminating possible flutter in the last digit.

03430-90001

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